

AGRICULTURAL RESEARCH INSTITUTE
PUSA

Nature

A WFEKLY

ILLUSTRATED JOURNAL OF SCIENCE



Nature

V WELKLY

ILLUSTRATED JOURNAL OF SCIENCE

VOLUME XLIV

MAY 1891 to OCTOBER 1891

" to the send yound

Of Nature trusts the mind which builds for are -- World Swot (ii)

Fondon and New Hork
MACMILLAN AND CO
1891

RICHARD CLAY AND SONS, I DUTTED, LONDON AND PUNGAL

INDFX

ARBADIE (A d'), a Straight Hand, 444
Abhé (Prof. Cleveland). Cloud Heights-Kinematic Method.

Abbé (Prof. Cleveland), vlosu Isleignts—nancauxie assume, 3000 fb. 8 Ny. on Diphtheran, 509 Abboth (Prof. 1878). This agount Address at the Annual Spring Meeting of the Iron and Steel Institute, 42, Society of Arta Albert Medal for 1889 awarded to, 184, 301 Aberration, the Constant of, 50; 1, Influence of, upon Observations of Salar Prominences, M. Fizeu, 300 Arrey (Captan W de W., P. R. S.) Colour Mensurements and Mutture, 313 Appaintus to show Greater Sensitiveness of Abboth Charles Villagement of These Advanced Statute and Statute of These Advanced Statutes and Statute of These Advanced Statutes and Statute of These Advanced Statutes and Statut

Abouker, Discovery of Three Colossal Statues at, 575 Absolute and Gravitation Systems, Frederick Slate, 445 Academy's, French, 20,000 franc Prize voted to Elisee Reclus,

Academy of Natural Sciences of Philadelphia, 353

Academy of Natural Scences of Philadelphia, 353
Acclimatization, Dr. Robert Felhicon, 508
Acclimatization of Plants, &c., in Russin, 385
Achevements in Engueering, I. Vernou-Harcourt, 147
Achevements in Engueering, I. Vernou-Harcourt, 147
Acoustics the Testing of Tuning forks, 152, on the Intensity
of Sound, and the Energy used by Organ-pipes, C. K.
Wada, 310, it he Production of Musical Notes from Non
musical Shods, Ceel Carus Wilson, 322

Actinotracha, Localities where found, 416
Adami (J. George): Laboratory Reports of the Royal College
of Physicians of Edinburgh, Vol. 111, 73, Immunity,

of Physicians of Edinburgh, Vol 111, 73, Immunity, Natural and Acquired, 422
Adams (Maithew A.), on Diphtheria, 369
Adams (Prof W. G., F.R.S.), Comparison of Simultaneous Magnetic Disturbances at various Observatories, and Determination of the Value of Gaussian Coefficients for those Ob-

servatories, 237

Aden, Voracity of Rats at, Capt. R Light, 600 Admiralty, Hydrographic Department of, 500

Advertisements for Instructors, 565
Aeronautics New Method of determining Vertical Motion of Aeronauts, A. Duboin, 144, Experimental Researches on Mechanical Flight, Prof. S. P. Langley, 277; Maxin's New

Mechanical Flight, Prof. S. P. Langley, 277; Math.'s Yea, Flying Machine, 303

A. Daboin, 14;
A. Daboin, 14;
A. Daboin, 14;
A. Daboin, 14;
A. Macteorology and Climatology of Northern, W. I. Dallas, 529

Africa, Major Claude M. Macdonald, on the Benue and the

Arica Mayer Claude M Macdonald on the Benut and the Khbbe, 46. Ornithology of Lack Victora Napara, Emin Pahha, 87, Cetaceans in African Lake, 124, 198, and Account of the First Ascent of Kulmanjar, by Dr Hans Mayer and Grand Mayer and M

Wales, 303; Proceedings of the Association of Agricultural Chemists, 317; Agriculture in Japan, Manuring

Experiments with Paddy, Dr. O. Kellner, Y. Kozu, Y. Mori, and M. Nagaoka, 153. Dairy Work in New South Wales, 436. International Agricultural Congress, 450. Agricultura in New South Wales, 451. Agricultural Entomology, Resignain New Youth Wales, 451; Agricultural Entomology, Resigna-tion of Miss Omnord, 451; 385, Contemplyide Central Agricultural Institute in Kinsia, 502, Victoria, Department of Agricultura, Summary of Tasks undertain by, D McAlpine, 539, the Farmers and the Victoria Department of Aericulture, D A Crichton, 550, Projected Agricultural and Mediumical College at San Isalo, Brazil, 549 Air New Grammerez Melbod of acertaining Composition of

Atmospheric, A. Leduc, 31r, the Expansion and Compressibility of Atmospheric, A. W. Witkowski, 312

sublity of Atmospheric, A. W. Witkowski, 312.
Art pressure and Temperature on Summit of Sanablick, Stadies of, Dr. J. Hann, 112.
Arty (Sur. B. B., F. R. S.). Completion of his Ninetieth Year, 302. his Popular Astronomy, 319.
Aiken (John, F. R. S.). a Method of Counting, Water Particles.
Aiken (John, F. R. S.). a Method of Counting, Water Particles.

in For, 119 , on the Solid and Liquid Particles in Clouds,

Anken (Edith), Elementary Fext book of Botany for the Use

of Schools, 467 Alaska, Prof. Russell's Excursion to, 629 Albatross the Wandering, a Remarkable Characteristic of, Sir Walter Buller, F R S . 502 . a New Species of, Sir Walter

Watter Haller, F. K. S., 502, a New Species A, Sir Walter Baller, F. R. S., 602 Albert University, the Proposed, W. T., Thiselton Dijer, F. R. S., 796, Prof. E. Ray I ankesten, F. R. S., 222, Prof. C. Carey Footer, F. R. S., 223, 257, Prof. G. Croom. Roberts no., 248, Rev. D. A. Irung, 248 Alcook, (Ur. A.), the Crasse of the Interface of Sp. 528 Alcook, Wascular Strength diminished by, N. V. Grichant and

Quinquaud, 135

Quinquaud, 135 Alcohol, Physologucal Effects of, Dr. Samuel Wilks, 353 Alcoholism, Prof. Harald Westergaard, 484 Alexandroff (N.), the Molecular Weights of Albumen, 358 Algebra, Solutions of the Examples in Charles Smith's Flemenlary, A. G. Cracknell, 444
Algebra, on the Evolution of Prof. F. W. Hyde, 470
Algerra, the Fosene Formations of, MM. Pomel and Eucheur,

Alkyl Sulphides in Petroleum Oil, 89
Allen (Laurence), Defective Ventilation in American Schools,

476
Allen (W. D.), Fouging Piess, 579
Alloy, Brilliant Parple Gold and Alaminium, Prof. Roberts-Austen, III

Auranac, the Nautical, 593
Alphabet of Motions, J. S. Dismotr, 225
Alpine Flora, the, T. D. A. Cockerell, 6, J. Innes Rogers, 6,

1. Lovel, 83 Alpine Glaciers, the Variations of, 389
Alsace Lorralne, Meteorological Service Established in, 233
Alternate Current Motors at the Frankfort International Electri-

cal Exhibition, 615

cal Eshbitton, 615
Alam Soluton, Hary Napier Draper, 446, Ch. Ed. Guilliume,
540; Shelford Bufwoll, F. R. S., 565.
Ambeford Cedar Lake, the wo culled, 1. Harrangon, 584
Ambeton, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 1998, 19

America, 183, American Ethinological Expedition to Laba dor, 185. American National Geographic Society, 251 of the 187 of the Fineton's and Nature of the lather of Spiese, 273.

Section C -Chemistry, Biological Functions of the Lecthines, by Waller Mixwell, 471. Section D—Mechanical Science and Engineering, B 1 Fermor on Government Timber Tests, 471. Section E—Geology and Geography, 1970 J J Sevension on the Idealium of the Cheming and Carlottine Timber Tests, 471. Section E—Bodder, 1970 J Sevension on the Idealium of the Cheming and Carlottine Intelligence of the Intelligence of the Intelligence of the Intelligence of Systematic Botany, 472. Section II—Bodder, 1970 John M Coulier on the Future of Systematic Botany, 473. Section II—Conomic Section III—Authoropology, 473, Defective Veniliation in Section III—Authoropology, 473, Defective Veniliation in Burraa, 593. Geological Security of American Coulier International Geological Excursion in, 629. Amerique Indiana et Michaella, 1971 Section III. Indians at Nicaragua, J. Crawford, 502

Ammonium Sulphovanadate, Crystallization of Drs. Kinss.

and Chamais, 19
Amphioxus, the Later Larval Development of, Arthur Willey,

21, 2022
Amsterdam, Royal Academy of Sciences, 72, 144, 288
Anzesthesia, by Subcutaneous Injection of Distilled Water, Production of Local, Dr. Sleich, 452
Anatomy of Helodierma, (r. A. Boulenger, 444

Anderson (Dr.), on the Constitution of Ordinance Factories, 578 Anderson (William), proposed Fellow of the Royal Society, 15 Andes, Transandine Railway across the, 87 André (Ch.), Caloninetric Research on Sugar derived Hunne

Aud, 144 Contributions to the Study of Atmospheric Electricity, 210

Andrew (James), Pugnacity of Male Ostrich in the Nesting Season, 452
Andrews (1hos. F.R.S.), the Passive State of Iron and

Steel, 92 Aneroid Barometer and Leibnitz, 40

Animal Chlorophyll, Dr. Ludwig von Graff, Prof. E Ray Lankester, F R S., 465 Animal Life on a Coral Reef, Dr. S. J. Ilickon, 90 Animals, the Evolution of, F. Priem, R. Lydekker, 243
Annelid, the Protective Device of an Arnold T. Watson, 507
Annualie de l'Observatoue Municipale de Montsouris, 576

Anschutz's Photographs of Rapid Movements, 352

Anchair's Patergraphs of Kapid Movements, 33

Annaretic kyaelution, Banon Nordenskod's proposed, 21

Anthropology the Dimmution of the Jaw in Civilized Racey, 37

5, Opening Address in Section II, by Prof Max Muller, 37

5, Opening Address in Section II, by Prof Max Muller, and Anna and Chests of Paskodu Islanders, presumably famed by cartiant Padding, J J Louer, 495: Rarny of Colour Blandens in Savage Races, Dr. L. W. Pox, 477, Prof K. Deorgias on the Novani and Kediguos focas of the K. Deorgias on the Novani and Kediguos focas of the the Marquis of But on the Language of Tunerific, 511, Jr. I. B. 714, e. Fi. S. o. no Savage Reklupon, 511, N. F. Peal on the Marquis of But on the Language of Tunerific, 511, Jr. S. P. Peal on the Marquis of the Natives of Anan, 511, Dr. Gasson on the "Muntantan Chant," 511, P. S. 11, N. St. Peal on the Marquis Chant Chant, "511, P. S. 11, N. St. Peal on the Marquis Chant Chant, "511, P. S. 11, N. St. Peal on the Campain Chant Chant," 511, P. S. 11, N. St. Peal on the Marquis Chant Chant, "511, P. S. 11, N. St. Peal on the Campain Chant Chant, "511, P. S. 11, N. St. Peal on the Campain Chant Chant, "511, P. S. 11, N. St. Peal on the Campain Chant Chant, "511, P. S. 11, N. St. Peal on the Campain Chant Chant, "511, P. S. 11, N. St. Peal on the Campain Chant Chant," 511, P. S. 11, N. St. Peal on the Campain Chant Cha structive Criminality, 511, J. I. Man on Nicobar Pottery, 612, the Melaneauns, Stadies in their Anthropology and Folk-lore, Dr. R. H. Codingion, 613, Primitive Man and Stone Hammers, J. D. McGurie, 630
Antiteptic, Microcodine, a New, Prol. Berlior, 232
Anti, White, Jackals and Juagle Cooks, 30
Aquatic Irsects, some Difficulties in the Life of, Prof. L. C. Mall, 457
Mail, 45

Discovery of Anglo-Saxon Skeletona near Lewes, 575; Mr. C. L. Wacker's Archaeological Researches in South-West New Mexico, 576, Album de Paléographic Opte, pour aevur 3 l'Introduction Paleographique. Jes Actes des Martys de l'Egypte, Henri Hyremsi, 609, Filiden-Petite on Exploration in Fg.19, 630
Artic Expedition, Lieutenant Pearry's projected Botameal,

231

Argyll (the Duke of, F.R 5), the Green Sandpiper, 274

Arloing (Dr S), 1 es Virus, 27 Arloing (Prof), Alleged Danger of Consuming Milk and Meat

Arlong (Fro I), Alkged Danger of Consuming Milk and Meat of Tubersubon Annuals, 260. The Function of Chorne in Archive Chorne, 11, Bromo derivative, of Beanaphthol, Action of Natice Action of N electrolytes, 287

Arsenic for the Preputation of Plants, Danger of using, 232 Art, Gallery of British, at South Kensington and the Science

Museum, 37, 255, 388
Art. Physical Science for Artists, Prof J Norman Lockyer, F R S , 175, 227

Art. the Existing Schools of Science and, Oliver S Dawson,

547 okes Jerusalem, at Different Periods of Growth, Variation of Composition of C. Lechartter, 668
Ascalans, the Classification of, Prof. W. A. Herdman, 130

Aslimolean Society, 111

Asia, Prof. Vambery on British Civilization in, 88

Asia, Prot. vamiliery on british Civinzation in, oo Asiatic Wild Sheep, Specimens of, at the British Museum, 40 Asiam and Burniah, Botanical Survey in, Dr. King, 549 Asiam, Mr. W. L. Sclater's projected Collecting Expedition to

Upper, 598
Assmann (Dr. R.), the Aspiration Psychrometer and its Use in

Assument (or K.), the Aspiration Caylerine and its own in Balloons, 512
Asteroids, New, 164, 438, 453, 504, 530, 578, 631
Astronomy Prof 1 Norman Lockyer, F.R.S., on Some stronomy Prof I Norman Lockyer, F.K.S., on Some Points in the Early History of Astronomy, 8, 57, 107, 199, Apparent Flattening of the Vault of the Heavens, Prof Reimann, 67, Astronomical Column, 69, 89, 115, 138, 164, 87, 129, the Constant of Aberration, 90, the Meridian Pho-tometer, 115, Report of Harvard College Observatory, 115; the Solar Parallax and its related Constants, Prof W Harktometer, 115. Report on travels of the the Soft Paralla and its related Constants, Prof W. Hark-nes, 115. Observation of Passage of Mercury acros Suri, Deb., May 9, 1684, D. Egnits, 119. Determination of Deb., May 9, 1684, D. Egnits, 119. Determination of Report Constants, Prof. E. C. Pelcertte, 129. the Percent of Double Stars, Prof. E. C. Pelcertte, 139. the Percent Good Observation, 176 E. C. Pelcertte, 139. the Percent Resident, 138, Newly discovered Marking Destruction, 1890, M. Perrolin, 168, Brockis Comet, 1890 of June 6, 1890, M. Perrolin, 168, Brockis Comet, 1890 of June 6, 1890, M. Perrolin, 168, Prof. Percent. 1890 of June 6, 1890, and L. Pecart, 168, Prof. Percent. 1890 of June 6, 1890, and L. Pecart, 168, Prof. Percent. 1890 of Marchael Constants, 1890, and L. Pecart, 1891, and 1891 Report on Oxford University Observatory, 184, Observations of Woll's Periodic Comet, 192, 478. Death of Norman Pogson, 205; Formation in Berlin of a Union of

ments to Western University of Pennsylvana and Alleghery Observatory, 321; Prize offered by Fualtich Jalkonowsky Gesellschaft, 185; Researches on the Mean Dennity of the Jalkonowsky Gesellschaft, 185; Researches on the Mean Dennity of the Jalkonowsky Gesellschaft, 185; Researches on the Mean Dennity of the Jalkonowsky Gesellschaft, 185; Researches on the Mean Dennity of the Jalkonowsky Gesellschaft, 185; Researches on the Mean Dennity of the Mental of Language of the Mean of Signature of Language of the Mean of Signature of Language of the Mean of Signature of Mean of Signature of the Mean of Signature of Signat Sir Robert Stawell Ball, F. R. S., 589, Distribution of Lunar Heat, trank II Very's, 601, an Axtronomir's Work in a Modern Oh crvatory, Dr. David Gill, F. R. S., 603, Tempel-Swif's Periodic Comet, G. Bigourdan, 608, Perional Equation in Transii Observations, P. Striowani, 608, the Zodiacal Light and Autorix, M. A. Veeder, 531, Comet e 1891, 631, Dauble Stan, 631, Jupiter's First Satellite, 631

Double Stars, 631, Jupiter's First Satellite, 631
Athens, Earthquake at, 40
Atkins (Tommy, Sen), W = Mg, 493
Atkinson (Rev J C), Forty Years in a Moorland Parish, 122
Atkinson (R. W), Meeting of the British Association at Cardif, 204 Atlantic, Pilot Chart of Noith, for July, 28t, for September

Attaute, First State 1891, 501
1891, 501
Atonie Weight Determination, Stav's Work in, 134
Attachés, Engineer, to Austrian Embassies, proposed, 575
Auerbach (Prof.), the Measurement of Hardness in Transparent

Bodies, 282

Aurora seen at Ambleside, Mr. Tuckwell, 475 Auron seen at Ambleude, Mr. Tuckwell, 475
Auron Boenish, a Nare Phenomenn, 494, 519, 541, W
Duppe-Crotch, 612, Prof. W N Hartley, P N. S. 614,
Marcon, Boenish, C. T. W. Scholmer, Green, 310
Aurora, the Heighth Of, T W Beckhouse, 527
Aurora, Codiscal Light and, M. A. Veeder, 631
Aurora, Codiscal Light and, M. A. Veeder, 631
Aurora, Codiscal Light and, M. A. Veeder, 631
Aurolahauspisher, Quatermous and the, Prof J Willard
Gibba, 79, Prof. P G. Tati, 105
Auroliah. Sutstitusiana Anacotation for the Advancement of

usiralis: Australasan Association for the Advancement of Science, 40, 400, 574, Esploition of Central Australia, Assander McPiece, 57, Meteorological Service of Australasan, Assander McPiece, 58, Meteorological Service of Australasa, Lancetts in the Australias Bash, Henry Dessa, 233, Earthquake Shocks as Italy and Australia, R. L. J. Ellery, F. R. S. 27, 21 the Australasan Marapual Mole, Noterator typhological Property, 18, 18, 40, Extraordinary Ramfall Die, P. L. Scider, F. R. S. 449; Extraordinary Ramfall Die, Noterator and Control Control of the Contro

Aption (Ford, W. E., F. R. S.) Quadrant Electronsters, 166
Alternate Current and Potential Difference Analogue in
Masheds of Measuring Power, 237; Construction of Non
indective Resistances, 56
Assigned, New Mehod of Peeparing, Drs. Noelling and
Grandmengin, 600
Anters, Earthquake in the, 475

B Sc. Exam., Lond Univ 1892, Edward I Barrell, 365
Backband W. Barrell, 365
Backband D. D. Enclor's Grant of Surveya 44
Backband D. D. Enclor's Grant of Surveya 44
Backersology I. D. Enclor's Grant Surveya 45
Backersology I. D. Enclor's Grant Surveya 47
Backersology I. D. Enclor's Grant Surveya 47
Backersology I. C. Enclory Backler Surveya 47
Backersology 1892
Backers and Buckmaster and Surgeon Major Ibomson, 161.
Backerson and her Products, Saint Woodblead, M D. 246, Bacteria and their Froducts, Sims Woodhead, M D., 246, Congress of Hygeine on Bacteriology, 419, Manuel Pratique d'Analyse Bacteriologique des Eaux, Dr. Mujuel, Prof. Perey F. Frankland, F. RS. 5, 513
Batley (G. H.), University of London, 105
Banes (A. C.), Soamp of Birds, 520
Baker (J. G., F. R. S.) * Hand-book of the Ferny of Kaltraria, 'I.

R Sun, 75, European Botany, Vol 1, K Richter, 100
Bakhuyzen (Prof Van de Sande), on Variations in Latitude, 69
Ball (Sir R Stawell, FRS) on the Cause of an Ice Age,

Ball (3rr R Stawell, FRS) on the Cause of an Ice Age, 480, the Story of the Heavens, 589 Ball (V, FRS): Cetaceans in African Lakes, 198, the Kohi Nur, a Reply, 592 Balloons, the Aspiration Psychrometer and its Use in Balloons,

Dr R. Assmann, 512 Baltimore Fishing School, the, 549

Bang (Dr.), Tuberculosis, 395
Bangor University College, Flectricity in the Physical Depart-

ment, 18 Barber (Mr. C A), appointed Superintendent of Agricultural Department of the Leeward Islands, 217

Department of the Leewan I Islands, 27 Bardow (Dr.), Dath of, 435 Bardow (Dr.), Luberculosis in Children, 397 Barnad (E. E.) Observations of the //sincal Counter Glow, 135, Physical Apparame of Perfolic Counter, 52 Barnes (Lucturean II.), Mark Coling in Western India, 42

Barometer, the Aneroid, and Leibnitz, 40
Barometer at Ben Nevis Observatory in Relation to Wind, Dr.

Buchan, 167 Barometrie Depression, Erratic Track of a. Rev W Clement

Ley, 150

Barrington (Sir Vincent) and Surgeon General Bostock, the Horpital and Ambulance Organization of the Metropolitan Asylums Board for the Removal and Isolation of Infectious Diseases, 486 Basalt, the Specific Heat of, 456

Batelli's (Signor) Exp riments on Water evaporation in Sun and in Shade, 136

Bateman (Dr), elected Associate of Paris Academy of Medicine, 351 Bateson (W.), Supernumerary Legs and Antenny, in Beetles,

188 Beam (William) and Di Henry Leffmann, I vanination of Water for Sanitary and Technical Purposes, 102 Beare (Prof. Thomas Hudson), Franslation of Luigi Cremona's

Graphical Statics, 221

Graphical States, 221
Beaumont on Screw Propellers, 510
Becquerel (Edimond), Death of, 39
Becquerel (Henri) on Underground Temperatures, 632
Bees and Honey-dew, F. M. Burton, 343
Bees in New Zealand, 6, M. Thouson on, 19

Bees, Remarkable Instance of Frugality in, W H Harris, 550 Beetle, fam Curculionide, as an Example of Protective Colontion, a New South Wales, Mr Froggatt, 576
Beetles, Supernumerary Legs and Antenne in, W Bateson,

Belgian Academy of Sciences, Subjects for Prize Competition Proposed by, 135
Bell (Alfred), Post-Tertisry Marine Deposits on South Coast of

Bell (Alred), Post-1 erusty marine Deposits on Annual Court of England, 191
Bell (John), a Dog Storp, 521
Ben News Observatory in Relation to Wind, Barometer at, Dr Bachan, 167
Ben News, the Winds of, R T Omoni, A Rankin, 191
Bendire (C), on the Collection, &c., of Birds' Fg54 and Nests,

502

503
Bengal, Earthquakes in, 185
Bennett (A. R.), on Underground Parcels Delivery, 510
Bennett (Alfred W.), Acral Roots of the Mangrove, 370
Benz's (Theodore) Investigation of Zignsaliye Ruins, 451
Benué and the Kibbé, Major Claude M. Macdonald, 46
Beng (Hers), Snow-observation in Russia, 113

vin

Bergeron (Dr.), on Diphtheria, 369

Bergeron (Dr.), on Diphtheria, 369
gerget (Alphones), Phiotography in Culours, Prof. R. Meldols,
Berkeley (Bullou), Memorial, the, 575
Berkeley (Bullou), Memorial, the, 575
Berlin Academy of Sciences, Recent Grants by, 136; the
Imperial Physical and Technical Institution at, 154, Forma
tion of Union of Friends of Astronomy and Counical Physics, 206; Berlin University, 35t

206; Berlin University, 35t
Berling (Prof.), Microcelline, a New Antiseptic, 232
Bernardinite, is it a Mineral or a Fungus?, J. S. Brown, 310
Berne, the International Geographical Congress at, 338
Berthelot (Daniel). Calorimetric Researches on Sugar-derived

Humic Acid, 144. Iron-Carbonyl and Nickel Carbonyl, 192, the Preparation of Iron Carbonyl and Several New Reactions of Nickel-Carbonyl, 208, Hears of Combustion and Formation of Nitrobenzenes, 360, Study of Chemical Neutralization of Acids and Bases by means of their Electric Conductivitie. 360

300
Beaut (W. 11, F.R.S.), Solutions of Examples in Elementary
Hydrostatics, Prof. A. G. Greenhill, F.R.S., 341
Bessemer (Sir Henry), Rolling of Steel Sheets direct from the
Molten Metal, 578

Molten Metal, 578
Beston (A.), Phosphod of Boron, 288
Best Books, the, a Contribution to Systematic Bibliography, by
Best Books, the, a Contribution to Systematic Bibliography, by
Bestold (Ford W. von), on the Theory of Cyclones, 437
Bible Countries, Barriel Clutes and, George St. Clair, 540
Bibliography, the Hell Blooks, a Contribution towards Systematic Bibliography, by William Swan Sonnenschem, 5, a
Guidet Books, or Banks, Studied by E. B. Sargani and Berthand
Guidet Books on Banks, Studied by E. B. Sargani and Berthand

Guide Book to Books, coned by E. P. Surgant and Deciminate Wishaw, 196, Bibliography of the Chemical Influence of Light, Dr. Alfred Tuckeiman, 208, Katalog der Bibliothek der Deutschen Seewarte zu Hamburg, 318, Forthcoming

sur Deutschen Seesarte zu Hamburg, 318, Forthooming steinfile Broke, 462, 478
Bickerton (T. H.), Colour blandness Generally Considered, 595
Bickerton (T. H.), Colour blandness Generally Considered, 595
Bi seed (Seelford, F. 85) he Effect of a fixed to the seed of the se

Bizourdan (G) Observations of Woll Tempel Swift's Periodic Comet, 6c8

Biology Miss Marshall's Bequest to the Science and Art Depart-in Analoumy of the indeeding, Dr. R. W. Soutsoft, 29th. Opening Address in Section D of the British Association, by Franch Darwin, F. R. S., 407. Consignificate Insulant, and Experimental Science of the British Association, by Franch Darwin, F. R. S., 407. Some 1 "lifeculars in the Life of Aquatic Insulant Acuts, IPr. Lindwig von Graff, Prof. E. Rey Lankwer, F. R. S., 465; Bloodjeel Panco and of the Lecthines, Water Maswell, 471. Biological Bearings of Fact of Stronger Maceptines of Water of Long than Short Light Verse, Herr Maswell, 471. Biological Bearings of Fact of Stronger Maceptines of Water of Long than Short Light Verse, Herr Maswell, 471. Water of Long than Short Light Verse, Herr Maswell, 471. Water of Long than Short Light Verse, Herr Schelberger of Stronger of Section Maturity in Plan, 482 pt. Company of Section 10 Planch 1847. J. T. Cunningham on the Reproduction of the Pitchard, 487; J. T. Cunningham on the Epopodual Processer of some Nukhenchente Mollusca, 482; Prof. W. N. Parker on Respiration in Tadpoles, 483; 170f. Hoves on the Classification of Fishesh by ther Re-1976. The Processer of Some Nukhenchente Mollusca, 483; 170f. Marcain on the Development of the Rat and the Mouse, 483; 170f. Marcain Strong Hards on Protoplasmic 483; Dr. Arthur Kobinson on the Development of the Rat and the Mouse, 483; Front Marcus Hartog on Protoplasmic Rejuvenescence, 483; Francis Darwin, F.R.S., on the Artificial Froduction of Rhythm in Plants, 484; Marine Bology, the Cruise of the Investigator, Dr. A. Alcock, 501, 518; a Difficulty in Weimannium, Prof. Marcus Hartog, 613: Huxley Laboratory for Biological Research, and the Marshall Sch olarship, 627

Birch Oil, the Manufacture of, in Connecticut, 391
Birds, Anipathy (?) of, for Colour, 31
Birds, Eggs and Nests, the Collection, &c, of, C. Bendire,

Birds Nesting in Western India, Lieutenant II E Barnes, 42 Birds, the Soaring of, S E Peal, 56, A C Baines, 52 Birds of Victoria, the Insectivorous, C French, 162

Birds, Wild, Protection Act, 65 Birmingham School of Medicine, Account of, 18 Bishop (Sereno F), the Great Comet of 1882, 293

Bismuth, Thermo electric Position of, Prof Knott, 311 Black-Farth Steppe Region of Fast Russia, the Northern Limits

of, Korzchinsky, 326
Idackie's Science Readers, 540
Blanchard (Emile), Proofs that Asia and America have been

Blanchard (Emile), Proofs that Asia and America have been recently connected, 335 Blanckenhorn (Dr. Max), Geology and Physical Geography of North Syria, Prof. Edward Hull, F. R. S., 99 Blanford (Henry F., F. R. S.), M. Faye's Theory of Cyclones,

Blow fly, Anatomy, Physiology, Morphology, and Development of the, B Thompson Lowne, 123 Board of Trade Committee on Electrical Standards, the Report of the, 417

Bollers, Papers on, 20
Bologna Academy 1000 Lire Gold Medal offered by Bologna
Academy for Memoir on Best Means of Fire Prevention,

Bonney (Prof T G . F R S) and General C A McMahon on the Crystalline Rocks of the Lazard District, 22, the Ice Age in North America, G F Wright, 537

Books, the Best, a Contribution to Systematic Bibliography, by

William Swan Sonnenschein, 5 Books, a Guide book to, 1 B Sargant and Bernhard Wishaw, 106

Bornet (Dr. Edouard), Linnean Society Gold Medal awarded to. ...

Born-tein (R), Connection between Air-pressure and Horn-angle of Moon, 281

Bort (1, Tenserenc de), the Various Kinds of Gradients, 469 Bostock (Surgeon-General) and Sir Vincent Barrington, the Hospital and Amhulance Organization of the Metropolitan Asylums Board for the Removal and Isolation of Infectious

Adynum Board for the Removal and Isolation of Infectious Diseases, 486 Boaton (U.S.), Proposed Confegura Gardens un, 18, 549 Boaton (U.S.), Proposed Confegura Gardens un, 18, 549 Boaton (H.S.), the Claudistica of Lincal Parial Confeguration of Lincal Parial Confeguration of Evidence of Evidenc Prof. Pensig* Contemplisted Expedition to Massownh and Bogo, 305; the Flowers of the Pyrenes and their Pertilliation by Inness, Prof. j. Mackod, 211; Duengagement of Coygen by Star of Bethlehem (Creatifogation) preventure). Dr. R. A. Proor, 215; the True Nature of Callus, Spencer Moore, 216; Luettenant Penya? Projected Bottomical Expedition Adot to the North Pole, 331; Danger of Using Arsenic for the Prepara-tion of Plenta, 322; Inducence Usax real Factors on the Small of Plants, Herr Regel, 232, Botanical Gazette, 236, 335,

559; Our Conniry's Flowers, W. J. Gordon, 247. Obstussy Notice of Cardinal Haynald, 256. Flora of Tropical Africa, 257; New Indian Lakiata, Dr. D Prain, 258, the Vegetation of Tubet, 260, are Seedlings of Humerocalitis fulne Specially Variable, Prof Marcus M. Hartog, 247, the Gragn of the Flora of Greenland, Clement Rend, 259, Relation of the Source Mercus and Forms and Chrastettes of Flowers, 27. Masters, 319, Brust and Brus of Japan, Dr. Maswell T. Masters, 329, Bonancal Survey of India, 347, 166-0-lotanneal Notes on the Flora of European Russia, D. J. Litvinoff, 399, Acreal Rossion of the Whate Mangrove, 324, Alfred W. 399, Acreal Rossion of the Whate Mangrove, 324, Alfred W. 399, Acreal Rossion of the Whate Mangrove, 324, Alfred W. 399, Acreal Rossion of the Part of the Exchange Club of the Bruish Isles, 391, Frances Darwan, F. R. S. on Gravith Curvatures in Plants, 497, Bonany of Plowering Plants, Mille C Sokolows, 427, Bohatay C H. Kanteria, 467, Leinentary Text book of Bottany for the Use of Schools, Edith Anklen, 467; Some of the Possibilities of Economic Beasty, Plor G Loo Goolda, 469, on the Fauture of Systematic Bastay Prof John M. Coulter, 472, and Flower, 477, Francis Darwin, B R S, on the Artificial Production of Khythm in Plants, 484, Flowers and Insect, 67, Soott Elinds, 488, Sleep Movements in Plants, 6. Ger, Flord Kein, 500, American Expeditions to Investigate Flora of Mexico, 500, (Diversyoning in Australia, Principal Plota of Mexico, 500, (Diversyoning in Australia), Principal Plota of Mexico, 500, (Diversyoning in Australia, Principal Plota of Mexico, 500, (Diversyoning in Australia), Principal Plota of Mexico, 500, (Diversyoning in Australia), Principal Plota of Mexico, 500, (Diversyoning in Australia, Principal Plota of Mexico, 500, (Diversyoning in Australia), Principal Plota of Mexico, 500, (Plota of Plota of Me Mechan, 335; Pines and Firs of Japan, Dr Maxwell T. Tandley, 493, Acclusatization of the Lacquer-Tree at Frank-fort, Ford Keng, 500, American Expeditions to Investigate Thomson, 501, Cultivation of Iolaccio in German New Gunes, 502, "Kamin," a New Species of Truffe, A Chatin, 512, Bush Friends in Lasanana, Mrs. L. A. Merchith, Chatin, 512, Bush Friends in Lasanana, Mrs. L. A. Merchith, Flowering Plaint, C. F. S. Elhott, 438, the Distribution of Manne Alga, C. Murray, 538, Oesterrochische Botanoche Estings, 538, Dr. Pallares, Collections in Western Cestings, 538, Dr. Pallares, Collections in Western Committee, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987, 1987

silion of Jerusairm Aritichoxes at Different Feriods of Growth, G. Lechartier, 608
Boulenger (G. A.), Analony of Heboderma, 444
Bournemouth, Meeting of the Brush Medical Association at, 161; Earthquake at, Henry Cecl, 614
Boutroux (Lobo), the Fermentation of Bread, 336
Boutro (E. Cho), the Fermentation of Bread, 336
Bouty (E.), Dielectric Properties of Mica at High Temperatures, 168
168

Bower (Frederick Orpen), Proposed Fellow of the Royal Society,

15 (C. V.) Picket Electrometers, 262.

Better KN. Nie Electrometers, 262.

Better KN. Nie Electrometers, 262.

Better KN. Nie St. and Rectonic, New Minerals of the Rectoric Kn. Nie St. and Rectoric Kn. Schlich, 262.

Schlich, 262.

Braunet, Ch.), De Lanhanaum, 68.

Braunt, H. Morrae on the Chuntology of, 437.

Brant, Projected Agriculturi Mechanical College at San Paulo,

Bread, the Fermentation of, Léon Boutroux, 336 Brezina (Dr A), Capture of a Supposed Gem Thief at Vienna,

Brewerles: Proposed Utilization of Carbonic Acid produced

Breweries: 1 roposed. Omization of a Choome. Acto produced in Fernmentation of Sugar, 303
Brighton Aquarlum, Birth of Sea Lion at, 185
Bridon (Dr. Daniel G.); Races and Peoplet, 124; Yocabulartes from the Musquito Cosat, 600
Bristol Juversity College Calendar, 438
British Art, Gallery of, at South Kennington and the Science

Museum, 77, 255

Barrist Association: Meeting at Cardiff, General Programme, 65, 371; Preliminary Arrangements, 202, 289. Grants of the, 443; Arrangements for the Meeting at Edinbargh in 1892, 161, 398; Inaugural Address at Cardiff by William Huggins, LLD., F.R.S., 372

Section A (Mathematus and Physics)-Opening Address by ration of (Mathematica and Phys.c)—"Opening Address by Prof Oliver J. Lodge, 1.1. D. F. R. y. Fresident of the Section, 332. Prof Newton on the Action of Jippier on Comes, 453. W. E. Wilson on the Action of Jippier on the Prof. Section, 322. Prof. Newton on the Action of Jippier on Prof. Section 1.2. Se Copeland on Bright Streaks on the Moon, 454, Prof Oliver J Lodge, F. R. S., on Light in Modifying the Lifect of the Gravitational Attraction of the Sun, 454, Units and their Nomenclature, 454, Prof S. P. Thompson, F.R.S., on the Measurement of Lenses, and on a New Polarizer, 455, F T Trouton on the Propagation of Magnetization

on the McLassenson is close, and to a "control of the North Control of the Prophysics of the Prophysics of the North Control of the North Control of the Committee on the Lonation of Habita 1999, Report of the Committee on the Lonation of Habita 1999, Report of the Committee on the Lonation of Habita 1991, Report of the Committee on the Lonation of Habita 1991, Report of the Committee on the Lonation of Habita 1991, Report of the Committee on the Lonation of Habita 1991, April 1991, Prophysics of the Control of Temperature of the I iquid in which it is formed, 456, Report on the Isomeric Naphthalen- Derivative, 456, Profs Rucker and Roberts-Austen on the Specific Heat of Profs. Reuker and Kolertis-Austen on the Spreah. He is of Bealth, 45, 17 of 1. Chose, on an Apparatus for taking safety lamps, 456, 17 of 2. M. Hompson on Rate safety lamps, 456, 17 of 2. M. Hompson on Kate Lundard behaused by passage Raxis of Hydrogen Ashfulde and Solutions of citain Metals, 456 J. J. valiborough on the Action of Nitroyd Chorland on Unsaturated Cardon Compounds, 456, c. G. Mooron th. Disposal of Swenge, 54, 18, 14 flore in treating Ulycerdies with Alcoholic Spring and Cardon Compounds, 456, c. G. Mooron the Disposal of Swenge, 6, 11 ft. Hinton our treating Ulycerdies with Alcoholic Spring and Cardon Cardon

Potash, 456
Section C (Geology)—Prof. Boyd Dawkins, F.R.S., on the Channel Tunnel Boring and the Inscovery of Coul, 479. Silurian and Devonian Rocks of Pembrokeshire, 480. Palmontological Papers, 481

481, J I Cummingham on the Rate and Growth of Age of Sexual Ma'arity in Fish, 482, Prof. Herdman and J A Clubb on the Innervation of the Epipodial Processes of some Nudibranchiate Mollista, 482, Prof. W N Parker on Respiration in Tadpoles, 492; Prol Howes on the Classification of Finnes by their Reproductive Organs, 483; Prof Howes on the Gills of Fishes, 483; Dr Arthus Robinson on the Development of the Rat and the Mouse, 483. Prof Marcus Hartogr on Protoplasmic Rejuvenescence, 483; Francis Darwin, R. R., on the Artificial Production of Rhythm in Plants, 484

484. E (Conyady)—Opening delhers by E. G. Reventon, F. G. S. F. S. S. Frachen et al. Content of the Section at 1, Mrs. French Sheldon on East Africa, 508, Dr. Robert Felkon on Adomastation, 508, Colonel Holdsch on the Application of Indian Geographical Surrey Methods to the Application of Indian Geographical Surrey Methods to J. Scott Kellic on Geographical Education, 509, 508-509, W. Key on Ventiliano, 509; Sir Edward Reed on Sewerage, 509, W. Key on Ventiliano, 509; Sir Edward Reed on Methods on Sewerage, 509, W. Key on Ventiliano, 509; Sir Edward Reed on Sewerage, 509; W. Key on Ventiliano, 509; Sir Edward Reed on Sewerage.

the Proposed Channel Tubular Railway, 509, Prof W Robinson on Petroleum Engues, 509; W II Prece, F.R.S., on the London and Parts Telephone, 510, Prof C. Forbes on Electric Motors, 510; A. R. Bennett on Underground Parcels Delivery, 510, Major R de Villami on Serew Propliers, 510, Mr. Beaumont on Serew Pro-

on Stewe Propellers, 510, Mr. Bestamont on screw repellers, 510.

Pellers, 510.

Max Muller, Prevident of the Section, 483; Proff. R.

Max Muller, Prevident of the Section, 483; Proff. R.

Max Muller, Nesoni and Religions ideas of the Chimete,
510, Major, J. W. Fowell on Indian Languages, 511; the

E. B. I. Flyan, F. R. S., on Swage Religion, 511; S. E.

Peal on the Moneyof He Natives of Assm. 511; Dr.

Careno on Human Remans Gond and Vockburg, 511; Miss

Careno on Human Remans Gond and Vockburg, 511; Miss

Gerson on Human Remains tound in Yorkshire, 511, Miss Buckland on the "Monatain Chant," 511, Dr. S. A. K. Strahan on Instinctive Criminality, 511, E. H. Man on Nicobar Pottery, 512 British Earlthworms, Identification of Templeton's, Rev. Illi-

deric Friend, 273

British Institute of Preventive Medicine, 86, 97, 124, 301, 323

British Medical Association at Bournemouth, Meeting of, 161,

353 British Museum · Specimens of Asiatic Wild Speep at, 40, British Museum in 1896, Decrease in Number of Visitors to, 280, 352, Additions to the Bird Department, 451, Syste-matic List of the Frederick F. Edwards Collection of British Observe and Locene Mollusca in the Richard Bullen Newton, 610

British Rule, South Africa from Arab Domination to, 564 Brocken Spectres in a London Fog, A W Clayden, 95 Broden (Fredk J), the Recent Epidemic of Influenza, 283 Brooks (Prof. W K), the Oyster, a Popular Sammury of a

Brooks (Prof. W. K.), the Oyster, a Popular Sammury of a Sclentific Study, 490
Brown (J. Allen), Technical Education in Middlesev, 65
Brown (J. S.), Bernardinite, w it a Mineral or a Fungus 7, 310
Brunne (J. T., M.P.), Elected President of the Sunday Society,

135 Brunnow (Francis), Obituary Notice of, 449
Brunton (I)r T. Lauder, FRS) Supplement to the Textbook of Pharmacology, 41, on the Progress of Medicine,

Brussels Academy of Sciences, 24, 240, 312, 440, 560 Buchan (Dr.), Baroineter at Ben Nevis Observatory in Relation

to Wind, 167 Buckland (Miss), on the "Mountain Chant," 511

Buckmaster (Dr.), Leprosy Bacillus cultivated in Serum by. 161 Buckmaster (C), County Councils and Technical Education.

588

888 Buchner (Dr.), Immunity, Natural and Acquired, 420 Budar-Feul Academy of Sciences, Sir J. D. Hooker elected Foreign Member of, 237 Buller (Sir Walter, F. K. S.). a Remarkable Characteristic of the Wandering Albations, 502, a New Spec.res of Albatrons,

502 Bulleun de la Société des Naturalistes de Moscou, 359

Buried Cities and Bible Countries, Geo St Clair, 540 Burned Cities and Bible Countries, Geo St Clair, 540
Burnels and Assan, Botanical Survey in Dr King, 549
Burnels (G W N, I), Boshlester Observations, 283,
Burnell (Edward), B Se Exam. Lond Univ 1892, 565
Burton (F M), Bees and Honey dew, 343
Burton (Sr R F), Funeral of, 161 Busch (Herr), Variations in Sunset Phenomena, 599 Bush Friends in Tasniania, Mrs. L. A Meredith, 517
Bute (Marque of), on the Language of Tenerifie, 511
Butter Export from New South Wales to England, 303

Cacao in Cultivation in Ceylon, Kinds of, Dr Trimen, 185 Cahours (M.), on the Endowment of Research in France, 17 Cailletet (M.), Vapour tension of Saturated Water-vapour at Critical Point, 119

Calculus, Differential and Integral, Prof. A G. Greenhill, F.R.S., 170 Calcutta Indian Museum. Report of, 18, Completion of the

Calcutta Indian Museum . Neport ol, 18, Completion of the Catalogue of the Manunais in the, 32¢ Caldetwood on See Fubertes, 48† Caldetwood on Sever Earthquake in, 206; California Trees and Flowers, 477; Hot Winds of, Lieucenant J P Finley, 512 Callega (Dr. Camilo), General Physiology, 28

Cambridge: Philosophical Society, 96, 143, 191; Honorary Degrees on Scientific Men, 189, University Extension Students at, 205; the Study of the Classical Languages at, Scameron (Denald), a Magnificent Meteor, 343 Cameron (Denald), a Magnificent Meteor, 343 Cambrid (Mr.), Record of a Journey in Northern Corea, 233 Cambrid, Geological Survey of, 114 Cambrid, Geological Survey of, 114

Canadian Meteorological Service, Apper 101 100/01, 130 Cape Colony, Meteorology of, 432 Carbon Dioxxide, Production of Solid, Dr. Hausknecht, 42 Carbon Monsvade, Physiological Researches on, 392 Carbonic Acid Gas preduced in Sugar-fermentation in Breweies, proposed Ultivarion of, 303

Carbonie Acid, New Reseast of Isotherms of, E H. Amagat.

608 Cardiff, the Visit of the British Association to, 65, 204, 280, 371 Cardiogram, Displacements of Heart and, Dr J B Haycraft,

167 Carpenter (Dr. Philip Herbert, F R S), Obituary Notice of,

628 Cartography, Map colouring and, Major J W Powell, 506 Carulla (Mr.), Curious Phenomena in Melting Besseuer Scraps.

Carus (Dr Paul), the Soul of Man, 293

Cabind, Australian, Nest and Eggs of, A. J North, 207
Caucassa, New Glenzer discovered in, 452
Cavers in Oregon, Discovery of Enormous Stalactite, 258
Cavers, Stalactite, in Fasaman, Discovery of, Mr Morton, 576
Cayesu (L.), Diffusion of Three Distinct Forms of Titanumcault in Cretacous Strata of Norther France, 144
Ceci (Henry), Earthquake at Bounemouth, 614
Censue, Results of the Recent, N. A Hamphrey, 161
Censue, 1591; of the Farsh of St. George, Hanover Square,
Alleged Worthersens of, 593

Census of India, 18

Cephalonia, the Climate of, Dr Partsch, 320 Cerchal Localization, the Cioonian Lectures on, Dr David Ferries, F R S , 292 Cetaceans in African Lakes, 124, 198

Ceylon, Kinds of Cacao in Cultivation in. Dr Trimen. F.R.S. 185 Chabry (M), Pressure which can be produced by Electrolytic Generation of Gas, M. Cliabry, 577 Chamberlin (Prof. T. C.), Classification of the Glacial Pleistocene

Deposits, 504 Chambers' Lucyclopædia, Vol. VII., 173 Channel Tubular Railway, Sir Edward Reed on the Proposed,

509 509
Channel Junnel Boring and the Discovery of Coal, Prof Boyd Dawklas, F k S, 479
Dawklas, F k S, 479
Chaniste (O), Chemical Methods of Protecting Ruilroad-ties against Decay, 476
Chapman (A C, I), Compounds of Destrose with the Oxides of Nickel, 71
Charles (Dr. R H.), Craniometry of Outcaste Tribes of Panjab,

576

Charpentier (A), Oscillations of the Retina, 311 Charpentier (A.), Oscilations of the Retina, 311
Charpy (Georges), Action of Nitra Acid upon Iton, 216
Chain (A.), "Kammé, "a New Species of Truffle, 512
Chattetton (G.), on Sewerage, Ocharcate Chromatic Sensations
perceived by each of Two Eyes, 488. Colour-Sensation
executed in One Eye by Coloured Light Illusinating Retina

of other, 536 Cheese, Digestibility of Different Kinds of, Herr Klenze, 325 Cheeseman (T. F.), the Basking Shark in New Zealand Waters,

570 Chemistry · Crystallization of Ammonsum Sulphovanadate, Drs. Kuus and Ohnman, 19; Shitoon Chlorotribonaide, 19; Compounds formed by Mercurc Chloride, 48, a System of Inorganic Chemistry, William Raussy, F.R.S., 50, Chemical Society, 71, 118, 215, 287; Chitzonflorescene, 17. Hewitt, 71; Ethylic Thiaceteceate, Dr. C. T. Sprague, 71; the Function of Chlorine in Acid Chlorides, Prof. H. E.

Armstrong, F. R. S., 71; the Action of Nitic Acid on the Lignocelluloses, C. F. Crous and C. A. Beran, 71. Studies on the Formation of Substitution Bervaives, H. Goedon, 72. Compounds of Destrose with the Onder of Nieldon, 72. Compounds of Destrose with the Onder of Nieldon, 73. Compounds of Destrose with the Onder of Nieldon, 74. Compounds of Destroye Charles, 72. H. Action of Acid Charles, 73. Action of Administrate Charles of Destroyer of Benginser, W. Jecone Harrson, 102. Discovery of Brilliant Purple Gold and Alumanium Alloy, Perf Roberts-Austen, 111; Synthestration of Indign-carmine, Dr. Hermann, 124, Action of Adultse on Nitro compounds New Addition Compound of Thiocarbannies, J. E. Reynolds, R. S., 118; Action of Adultsen On Nitro compounds New Addition Compound of Thiocarbannies, J. E. Reynolds, F. R. S., 118; Action of Action Amydrades on Substituted New Addition Compound of Thiocarbannie, J E Regnolds, FR S., 118, Action of Acetic Anhydrides on substituted Thiocarbanides, and an Improved Method of preparing Aromatic Shatard Ols, F A Werrer, 112, Decomposition of Addition of Alcohol Elements to Ethereal Solit of Unsaturated Addition of Alcohol Elements to Ethereal Solit of Unsaturated Acids, T Purde and W. Marshill, 118, Acohol Ferrar and W. Marshill, 118, Acohol for Estimation of Antraes, G. McGowan, 118, Method for Estimation of Antraes, G. McGowan, 118, A Shaph Januarie, M. Modola, P. R. S., and feet litephes. A shape of the property of Thouards and the A. R. S., and feet litephes. The shape of the property of Thouards and the A. E. Ducon, 18, Mebb Ger Estimation of Nutries, G. McGowan, 118, New Bennyle Derwaltwo of Thouards and the Medical Control of the Minet, 130, Two New Crystalline Compounds of Platine Minet, 120, Two New Crystalline Compounds of Platine Minet, 120, Two New Crystalline Compounds of Platine Minet, 130, The New Personal of Platine Minet, 130, The New Personal of Sulphur, 1707 Transbe, 163, Dr. Gustawas Hinnah, on the Fissing and Transbe, 163, Dr. Gustawas Hinnah, on the Fissing and Phoppions Trifluoride, M. Monsan, 185, Nickel's urbon, 150, March 150, M. Monsan, 185, Nickel's urbon, 150, M. Monsan, 150, Nickel's urbon, 150, Nickel's u mination of Compounds of Aqueous Solutions of Man-nite with Acid Molybdates of Soda and Ammonium, 192, Proceedings of the Association of Official Agricultural Che-Proceedings of the Association of Omenia Agricultural Chemists, 1890, 317, the Preparation of Iron-Carlonyl, not several New Reactions of Nickel-Carlonyl, M. Berthelot, 2081 Molecular Refraction and Dispersion of various Substances in Solution, Dr. J. H. Gladvione, F.R.S., 215, Nature of Solutions as elucidated by Study of Densities, &c., of Solutions of Calcium Chloride, S. U. Pickering, 215, Note of Solutions of Calcium Chioride, 5 U Picketing, 215, Note on a Recent Criticism by Mr Lupton of Conclusions drawn from a Study of Sulphuite Acid Solutions, S U. Picketing, 215, Volatile Plaitnum Compounds, W Pullinger, 215, Reacarches on Osmium, Osmianic Acids and Osmianies, A. Joly, 216; Action of Nitric Acid upon Iron, H. Gautier and Joly, 216, Action of Nirica Acid apon Iron, H. Gantier and Georgie Charpy, 216, the Cryogon, an Apparatus for quickly Lowening Temperature by Expansion of Liquid Carbonic Acid, M. Ducriett, 233, Microcaline, a New Antiseptic, Prof Berliox, 232, a Volatile Compound of Iron and Carbonic Conde, Ludwig Mond and F. Quincke, 2343; Nigor of Flantie Congression, 1997, and Carbonic Conde, Ludwig Mond and F. Quincke, 2345; Cliff, H. E. Armittong, F. R. S., and G. H. Robertson, 237; on Persuiphates, M. Berthelot, 240; Cause of Insolubility of Pare Metals in Acids, Dr. Weeren, 259; an Exploive Compound resulting from Action of Brarty Water on Chromic Acid in Presence of Oxygenated Water, E. Fechaer, 44; Study of Terns-colded of Carbon, Hensi Kjonsan, 265, 44; Study of Terns-colded of Carbon, Hensi Kjonsan, 265, 268; a Series of Addition Compounds of Aldehydes with

Hypophosphorous Acid, M. Ville, 282, some New Reactions of Dehydracetic Acid, Dr. J. N. Collie, 287, Lactone of Triacetic Acid, Dr. J. N. Collie, 287, Re-Lactone of Iriscetic Acid, Dr. J. N. Colhe, 287, Re-fractive Powers of Certain Organic Compounds at Different Temperatures, Dr. W. H. Perkin, F. R. S., 287, the Forma-tion of Salts, an Introduction to the Theory of Electrolyses and of Nature of Chemical Change in Cive of Non Electrolytes, H E Armstrong, 287, Dibencyl ketone, Dr S Young, 287, Vapour Precure of Meigury, Dr S Young, 287, a New Copper Hydride and the Prepara ion of Pare Nitrogen, A. Leduc, 288 Action of Light on Silver Chloride, A. Leduc, 288 Action of Light on where Chloride, M. Guntz, 288, a New Gaseous Compound, Phosphorus Penta fluochloride, C. Poulenc, 288, Phosphotic of Boron, A Besson, 288, Artificial Production of Datolite, \(^1\) de Gramont, 288, on a Substance Analogous to Fisher Ferments con tained in Magnesium, Sulphate plasma, or Kalium oxalsteplasma, Her Pekelhaning, 288, a History of Chemistry from plasma, Herr Pekelhating, 288, a Hattory of Chemistry from the Earlest Times to the Present Day, Prof. Elisti von Meyer, Prof. T. E. Tronçe, F. R. V., 289, 1 from Carbonyl, Mond and Camber, Day. Prost consumers Uchnis of Aveerage Commence and Camber and Lawren and Lawren and Lawren and Lawren and Lawren and Promotion of Compound Educary, N. Merchathatin, 312, the Crystallication of Flux Layud Films, Prof. Litto Martin, 325, the New Cass, Chloroflowrice of Phospheria, V. E. Tatton, 333, Densities of Oxygen, Illydrogen, and Viringea, and Mon and plate Camber and Cambe 333. Persauer.

Ledac, 35. de Harnperror Midhle from mel Nickelly CynLedac, 35. de Harnperror Midhle from mel Nickelly CynLedac, 35. de Harnperror Midhle from mel Nickelly CynSalts of Copper, G. Rousseun and G. Tita, 35. Researches
and Oxadorn. Acads. W. C. Murgonn, 35. dis. Fermentation
of Read, Ledon Bontroux, 33. volatikity of Nickel under
Inflaence of Hydrochloric Acid. P. Schurzenberger, 356. the

Confloration of Explosive Gen. Wisturs, 343. Wolescular
Confloration of Explosive Gen. Wisturs, 343. Wolescular Influence of Hydrochlures Acol. P. "Mutremberger, 3.6", the Slow Combis-tion of Explosive Gen. Whaters, 5.4; Adlecular Weight of Albiemen, Sydam-eff, and Mexandroit 188, Mexantement of Density of Sea water, Vice. Adminal Makroff, 359, Prof. W. C. Kobere Austen, F. R. S., on Mexillargy, 393, Irinal Avocation Report on the Formation of Hilloud Salex, Orange and State of Sea Weight and Cond. 435, Ladwig Mond on Nickle cathon Oxide and Meallice Nickle obtained these from, 455, William Crooker, F. R. S., on the Electrical Evoporation of Weish and Alloys, 455, T. Turner on the Cause of the Red Blotches on the Surface of Brass Nigers, 455. "F. I varie on the Beletine Makroff of Brass Nigers, 455." F. J. Turner on the Alexton Austen, F. R. S., on the Self-technine Pytometry, 466." Surface of Brass. Speers, 455, 1. P. I name on the helections of Namos Alorys, 356, Prof. W. Cholert-Austen, F. R. S., on his Sufficiently, 356, Prof. W. Cholert-Austen, F. R. S., on his Sufficiently, 356, Prof. W. Cholert-Austen, F. R. S., on his Sufficiently, 356, Prof. W. Cholert-Austen, F. R. S., on his Sufficiently, 356, Income and Composition and Temperature of the I upual in which it is formed, 466, Incomers, 39th Income and Sufficiently, 366, Incomers, 39th Income and Sufficiently, 366, Incomers, 367, Income and Sufficiently, 366, Prof. Commercial Composition on American Sufficiently, 367, Income and Sufficiently, 367, Income and Sufficiently, 367, Incomercial Composition, 367, Incomercial Composition, 367, Incomercial Composition, 367, Incomercial Composition, 367, Incomercial Work in Organic Chemistry, Freile Wm Steatled, 466; Budgoteal Functions of the I exclusion, Walter Maxwell, 471; Aligament chemisthe, Marchaell, 367, Incomercial Composition, 367, Incomercial Composi

602; New Keitau of Isonorms on Canonic Rect, E. U. Amggat, 608; Further Researches upon the Element Fluorine, A. F. Tutton, 623 Chemung and Caskull, on the Relations of the, on the Eastern Side of the Appalacham Basin, Prof. J. J. Stevenson 471 Chicago: Reguest to the University of, by William B. Ogden,

388; the Coming Chicago Exhibition, 258; and the McKinley Bill, 351; Proposed International Conference of Electricians 14, 450, 575; Mines and Mining Department of, 476; Representation of Colorado at, 501, the "World's Fair,"

629
China: Is the Mariner's Compass a Chinese Invention?, 308,
Botany of the Chinese Classics, 428; the Social and Religious
Ideas of the Chinese, Prof. R. K. Douglas, 510
Chionne, the Function of, in Acid Chlorides, Prof. H. E.

Armstrong, F.R S., 71

Chlorofluoride of Phosphorus, A. E. Tutton, 333 Chlorophyll, Animal, Dr. Ludwig von Giaff, Prof. E. Ray Lankester, F. R. S., 465

Chree (C.) the Flying to Pieces of a Whiting Ring, 82, Experiments on Liquid Electrodes and Vacuum Tubes, 191 Chronograph, Stanley's Phonometer, a New Form of, 239 Chrystal (Prof), a Demonstration of Lagrange's Rule for Solution of Partial Differential Equations, 310

Cicada, the Song of the, 437 Cltraconfluorescein, J. T. Hewitt, 71 City and Guilds of I ondon Institute, and Instruction in Wood

City and Guida of Louion Institute, and Institution in wood work in Public Elementary Schools, 327 Clarke (J. F. M.), Geological Formation, exposed in Bridg water Kaulway Cuttings Househ Folden Hills, 530 Clayden (A. W.), Bricken Spectres in a London Fog. 95 Clirke (A. M.), the Sun's Motton in Space, 572

Clerke (A. M.), the Sun's Motton in Space, 572 Climate, Dr. Bruckner upon Variations of, 325 Climate of Cephalonia, the, Dr. Partich, 336 Climatology Anleitung zar Bealbeitung meteorologischer Beobachtungen fur die Chinatologie, von Dr. Hugo Meyer, 27

sates, 22 Ornation of the Chinalology of Northern Afghanistan, W. L. Dallas, 529.
Clock for pointing out Direction of Larth's Orbital Motion in Ether, Prof Oliver I Lodge, F. R. S., 238.
Clocer (Richardson), Graphic Diaily Record of the Magnetic Declination or Variation of the Compass at Washington,

U S A . 82

Cloud Heights, Kinematic Method, Prof Cleveland Abbe,

398
Clouds, Luminous, 231, O Jesse, 229
Clouds, on the Solid and Liquid Particles in, John Aitken, F.R S., 279
Clover, the Havour of Malites Honey delived from, 502
Clover, (Prof. Frank.), Apparatas for Testing Sensitiveness of

Safety-lamps, 260

Satety-intrip, 300 Clyde Sea Area, Physical Geography of, Dr. 11 R Mill, 167, Dr. John Muray, 332 Coradaptation, Prof R. Meldola, F R S, 7, 28, Frof George J. Romanes, F R S, 28, 55 Call and the Channel Tunnel Boring, Prof. Boyd Dawliss,

F R.S , 479

Coal, the Spontaneous Ignition of, Prof. Vivian B Lewes, 455 Coal in West Virginia, 87

Coladi, Electric Resistance and Thermo-Electric Position of, Prof Knott, 311 Cockerell (T. D. A.) . the Alpine Flora, 6, the Natural Selec-

Cockerel (T. D. A.), the Alpine I lora, o, the Natural Selection of Indiac Coin, 56
Cocoa Nat Leaf, Disease of, M. C. Potter, 167
Cococida, W. M. Maskell on the, 550
Codrington (Dr. R. H.), the Melaneans, Studies in their
Anthropology and Folk-Lore, 613
Coelho (Frof.), M. L.), Death of, 500
Coltrideau (M.), Vapour Tension of Saturated Water Vapour

at Critical Point, 119 Cole (Prof Grenville A. 1), Aids in Practical Geology, Prof A. H. Green, F R S, 25 Coleoptera of Yarkand, 318

College at San Paulo, Brazil, Projected Agricultural and

Mechanical, 549 Collie (Dr. J. N.): some New Reactions of Dehydracetic Acid,

287; Lactone of Triacetic Acid, 287 Collins (F. H.), the Diminution of the Jaw in Civilized Races,

Colorado, the Survey of the Canon of the, 437 Colorado at the Chicago Exhibition, Representation of, 501 Coloration, Protective, a New South Wales Beetle (fam. Cur-

cullonder) as an Example of, Mr. Froggait, 576
Colour-Associations with Numerals, &c., Dr. Edward S. Holden,

223
Colour-Blindness in Savage Races, Rarity of, Dr. L. W Fox,
477; Colour Tests used in Examinations for Mercantile

Marine, G. I. Swinston, 500. Colour-Bindness Generally Considered, T. H. Buckerton, 595. Colour-Bindness Generally Considered, T. H. Buckerton, 595. Colour-Measurement and Muture, Captain Abney, F.R. S., 313. Colours and Nouse, Startling, the Use of, Alfreid O Walker, S. Colours, Registration in Number of, and Appearate, To Captain Abney, F.R. S., and General Festing, F.R. S., 187. Comber [17], a Registre of Amphylerum pelurada produced with Cens. New York Wolfe, Co. and 1878, 111 July 2018. Comber [17], a Comet of Colour Colour Colours of Colo

Compounds, the Fusing and Boiling Points of, Dr. Gustavus

Hinrichs, 174

Confectionery and Birch Oil, 391
Congresses Vienna International Ornithological, 111, Interongresses Vienna international Congresses of Hygiene and Demography, 337, 344; the International Geographical Congress at Berne, 355, In the International Geographical Congress at Berne, 355, International Agricultural, 450, International Evictor technical, 450, of German Naturalists and Physicians, 499, the International Folk lore, 527, International Statistical, 527; International of Analytical Chemists and Microicopists, 574, Projected International Batanical, at Genos, 598

Conics, Elementary Geometry of, Dr. Taylor, 517 Conifers, proposed Conference on, 476 Conroy (Sir John, Bart.), proposed Fellow of the Royal Society, Cons (Miss Emma), Morley Memorial College, 469

Consumption the Prevention of Dr. Arihur Ransome, 369, Dr. Finkelnburg on the Influence of Soil on, 370 Contributions from the U.S. National Herbarium, 528

Cook (Mr. O F), projected Natural History Expedition to Liberta, 548

Librius, 548
Cook's Tours, the Bissues of Travel, W Fracer Res, 247
Cook's Tours, the Bissues for Ender Islanding Cook
Copeland (Dr. Kalph) on Bright Streaks in the Moon, 454; a
Rare Thenometon, 494
Copepola as an Article of Food, Prof W A Herdman, 273;
Copic Palsography, Henri Hyernari, 600
Coral Rest, Annual Life on a, Dr. b J Hickson, 90
Coral Rest, Annual Life on a, Dr. b J Hickson, 90
Coral Rest, Annual Life on a, Dr. b J Hickson, 90
Coral Rest, Annual Life on a, Dr. b J Horson, 90
Coral Rest, Annual Life on a, Dr. b J Horson, 90
Coral Rest, Annual Life on a, Dr. b J Horson, 90
Coral Rest, Annual Life on a, Dr. b J Horson, 90
Coral Rest, Annual Life on a, Dr. b J Horson, 90
Coral Rest, Annual Life on a, Dr. b J Horson, 90
Coral Rest, Annual Life on a, Dr. b J Horson, 90
Coral Rest, Annual Life on b, 90
Coral Rest, Annual Life on a, 90
Coral Rest, 90
Coral Res

Condylphona da. utlers., John Bidgoo I, 100, 1 Roomas beephears, 151, 1 Inters, Scherren, 435
Corea, Notthern, Record of a Jouiney in, Mr Campbell, 335
Cormi, Indian, He Natural Select in of, T II A Cockerell, 56
Comish (T. II) on some Remarkable Catches of Pish, 19
Correlation of Geological Formation, Mr Gilbert, 505, Prof. E. W Hilgard, 506
Cosmic Physics, the Society of Friends of Astronomy and,

507 Cosmical Evolution, a New Theory of the Mechanism of Nature.

Cosmical Evolution, a New 1 neory of the Mechanism of Paulus, Evan McLennan, 342 Coste (F. 11. Pers). Five Years' Pulse curves, 35, Tortoise included in 16c, 520 Cotes (E. C.), on the Locust in India, 18 Cotteswold Illia, a Microscopic Study of the Inferior Oolite of Cotteswold Illia, a Microscopic Study of the Inferior Oolite of

the, Edward Wethered, 95

Cotton-bleaching by Oxygenated Water with Calcined Magnesia. M. Prudhomine, 192 Cotton Cultivation in Russian Turkestan, 163

Coulter (Prof. John M), on the Future of Systematic Botany, 472

County Councils and Technical Education, Sir T. H. Farrer, 6, J. C. Buckmaster, 588 Coartenay (Right Rev. Bishop Reginald), the Spinning Ring, 106

Cowper (J.), Occurrence of the Ringed Snake in the Sea, 541 Cracknell (A. G.), Solutions of the Examples in Charles Snuth's Elementary Algebra, 444 Cracow Academy of Sciences, 312

Craniometry of Outcaste Tribes of Paniah, Dr. R. H. Charles, Craw Craw, the Disease, 367
Crawford (J.), the Amerique Indians of Nicaragua, 502
Cremona (1 uigi), Graphical Statics, translated by Prof Thomas Hudson Beare, 221 Criehton (D. A.), the Farmers and the Victoria Department of Agriculture, 550 Criminality, Instinctive, Dr S. A. K. Strahan on, 511 Cromer Forest Bed and its Fossil Mammalia. 612 Crook (H. T), on our Ordnance Survey, 508
Crookes (William, FRS) the Electrical Evaporation of Crosket (WHIIAM, F.K.S.) the Electrical Evaporation of Metals and Alloys, 212, 455, a Souvenir of Faraday, 230 Cross (B.P.), the Crowing of the Jungle Cock, 151 Crosskey (Rev. Dr.), on the Distribution of Erratics in England and Wales, 480 Croze (A), Analysis of Sunlight Diffused by Sky, 119, 144
Crozet's Voyage to Tasmania, New Zealand, the Ladrone
Islands, and the Philippines in the Years 1771-72 492 Islands, and the Philippines in the Years 1771-72 492
Grogen, the, an Apparatus for quickly Lowering Temperature
by Expansion of Liquid Carbonic Acid, M Dacciete, 232
Gystal Palace Electrical Exhibition, 450, 597
Grystal Bus And Coneral C. A M.Mahon, 250
F.R.S., and General C. A M.Mahon, 250
F.R.S., F.R.S. and General C. A. McMahon, 22 Gratallization, J. D. Liveng, F.R.S., 156 Cystallography for Sustents of Chemistry, Physics, and Mineralogy, George Huntingdon Williams, Piol John W. ladd, F.R.S., 193 Cystallogy, D. G. Ushmann on Micro-Chemical Analysis, 76 Cystals of Phitman, J. Johy, 124 Cystals of Phitman, J. Johy, 124 Cystals of Phitman, J. Johy, 124 Cystals, Chemistry Company, 1940, F.R.S., 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 1981, 19 Society, 15 Society, 15
Commandam (J T) on the Reproduction of the Pilchand, 481, on the Rate and Growth of Age of Sexual Maturity in Fish, 482
Curgenven (J Brendon), Excalyptus as a Disinfectant, 445
Cartis (For Geo E.), Run making in Texas, 594
Cartias (For), Neutral Sulphate of Hydraume, 550, the Ketazines, 551 Cycles, Weather, Prof J. P. O'Reilly, 541 Cycles, Weather, and Severe Winters, 591 Cycles, Weather, and Severe Winters, 591
Cyclone at Martinque, 416
Cyclone of August 28, 1891, the Martinque, 575
Cyclone Belts, Physical and Geological Traces of Permanent,
Maraden Man-on, 389
Cyclones, Carrents that give rise to, H Faye, 168
Cyclones, M. Faye's Theory of, Henry F. Blanford, F R S,

348
Cyclones, Prof W von Berold on the Theory of, 437
Cyprus, Orange Disease 10, A. E. Shipley, 528 Dairy Work in New South Wales, 436
Dallas (W. L.), Climatology of Northern Afghanistan, 529
Dallon, Death of one of the last Surviving Pupils of, 574
Damas (Damascus?), "Kammé," a New Species of Truffle from, A Chatin, 512 A Chatta, 512
Danish Academy of Sciences, Prizes offered by, 324
D'Arisowal on Stimulating Muscles by Means of Light, 390
Darries (Charles), his Life and Work, Chas. Frederick Holder,
Prof. K. Mediola, F. R. S., 337
Darries (Charles, F. R. S.) on Growth Curvature in Plants,
454
Darries and Charles, P. S. Darries of Species, Pranses P. Pacco,
247

Darwinian Theory of the Origin of Species, Francis F Fasco, Darwinian Theory of the Origin of Species, Francis F Fasco, Darwine de Mechanici Action on Rocks of Gas at High Fresures and in Rapid Mortina, 269, I mon in Gald Washings about Berezowski, 265, Frobable Rille of Gases in various Geological Phenomena, 260
Gases in various Gases of Gas

Dawson (Dr. George Mercer), Proposed Fellow of the Royal

Dawson (Dr. George aneren; proposes a summary Society, 15 Dawson (Diries S), Essuing School of Sources and Art, 547 Dawson (Diries S), Essuing School of Sources and Art, 547 Dawson (Diries S), Lamonout Insects in Australian Bauth, 233 Deep Well, Wheeling, W. Va, a Preliminary Report of O'servations at the William Hallock, 472 Definition, Photographic, A. Mallock, 573 man, 66 Delace (H), Mr. Cirk, Payra, e., Bennopinacoline, 312, Pinacone and Descrybearon, 312

Demography and Hygiene, International Congress of, 65, 307,

Demography and Sprind pulchella, a New Species of Calcarcous Demography (Arcthur) Sprind pulchella, a New Species of Calcarcous Demography (New York) (Arcthur) Spring (New York) (Arcthur) Demoning (New York) (Arcthur) (New York) (Arcthur) (Arcthu

Detining (W. F.) Lelescopic Work for Staright Evenings, 467, Jupiter and his Markings, 438?

Josephanes and his Markings, 438?

Beshandres (M.), Photogruphy of Solar Prominences, 438

Destanction of Morganicus, W. Mattieu Williams, 539

Destruction of Morganicus, W. Mattieu W. Matti

Dextrose, Compounds of, with the Oxides of Nickel, A C. Chapman, 71
Diamond Island, the Flora of, W Botting Hemsley, F.R.S.,

1 28 Diamonds, Emission of Light by, iii Darkness, G F Kunz, 88

Distoms C Haughton Gill on, 23, Grenfell on the Structure of, 481 Dickins (F. Victor), University of London Questi in, 54

Dickinson (Dr.), Harvey's Discovery, 597
Dickinson (Dr.), Harvey's Discovery, 597
Dictionary of Applied Chemistry, Sir II f. Roscoe, M.P.,
F.R.S., 268

Dictionary of the 1 iglish Language, Webster's, 102 Differential and Integral Calculus, by Prof A G Greenhill,

Prince that and Integral Calculus, by Prof A G Greenial, F R S, 170 mifficulty in Weismannism, n, Prof Marcus Hartog, 613
Dines (W. H.), on the Formation of Storms, 95
Dinotherum en Roumanie, sur l'Fristence du, Prof Gregoire

Stefanescu, 602 Diphtheria, the Congress of Hygiene on, 368 Disease and Population, Sindirs in Statistics, George Blundell

Investee and reputation, Sinda's in Statistics, George Blundel Longstaff, 4D blease and Weather, Herr Magelssen, 113
Distinctiont, Eucalyptus as a, J Brendon Cargenven, 445
Dismort (J. S.), an Alphabet of Motions, 225
Distinct (W. J.), Henricogn haritata and Danats chrysppur

Instant (W. 1.), Hemisaga haidala and Danais chrysippin (Butterly), 485 Ditte (Prof. A.), Leçons sur les Métaux, Prof. W. C. Roberts-Austen, F. R. S., 245 Dixon (A. E.), New Benzylic Derivatives of Thiocarbanuile,

118 Dixon (Edward I). Force and Determinism, 249, 319

Privon (Loward 1), Force and Determinent, 449, 319
Doberte (Dr.), Meteorology of the Easten bex., 950
Doelter (Dr. C), Allgemente chemische Mineralogie, 516
Dog in Ancest Egyri, M. Mapero, 207
Dog Story, John Rell, 521
Domeste Confort in United States, Science and, 554
Domeste Confort in United States, Science and, 554
Domeste, the Engineering Importance of, Mr. Willoock-, 301
Double-Star Observations, S. W. Burnham, 483

Double-Star Observations, S. W. Burnham, 283
Double-Star, Given Start St

Du Boys (P.), Fluctuations in Height of Lake Waters, 120

Duboin (A), New Method of Determining Vertical Motion of Acrostats, 144

Actorists, 144
Duck's Forethought, a Wild, W Prentis, 550
Ducretet (M.), the Cryogen, an Apparatus for quickly Lowening
Temperature by Expansion of Liquid Carbonic Acid, 232
Duncan (Dr. P. Martin, F.R. S.), Death and Obtuary Notice

Duncan (Dr. P. Matrin, F. D.), of 135, 387 Duntain (W. R.), Interaction of Alkalies and Nitroethane, 118 Duppa-Crotch (W.), a Rare Phenomenon, 614 Durham College of Science Calendar, 502

Durham College of Science Calendar, 502
Durham (William), Food Physiology, 500
Dutton (Captain), and Geology in America, 183
Dyer(W. T. Thuelton, F. R. S.), University of London Question, 52, the Albert University, 196
Dymond (T. S.), Interaction of Alkahes and Nitroethane, 118

Eakins (L E), New Analyses of Astrophylhte and Tscheffkinite, 310
Ealing Microscopical and Natural History Society, Report of, 40

Ealing Microscopical and Natural Hastory Society, Report of, so lang, Remarkable Meleva 1, 890m Crumium and Mann Discussion, and the Common Balance, J. H. Poynting, F. R. 3, 165. Earth, Retearches on the Ness Density of the, Fref A Coma, 37 Earth, Retearches on the Ness Density of the, Fref A Coma, 37 Louis of Prof. (Other J Lodge, F. R. 3, 28 Earth's Relation, Frof Padelletts on the Insufficiency of the usual Investigation for Novement of Ulbase of Occiliation of

Foucault's Fendulum in relation 10, 336
Earth-quirents and the Electric Rullsays, William Ellis, 127
Earthquakes, at Athens, 40, near 5t Faul's Rocks in the
Earthquakes, at Athens, 40, near 5t Faul's Rocks in the
Burchland; 1; r. Earthquakes in this, 13, 16, 16, 16, Recent
Earthquakes in Italy, 176 f J P O'Reilly, 297, the Earth
unders in Bergal and Italy, 186, p. Parthquake tooks in Italy
and Australia, R. I. J. Pillery, E R S, 206, 272, the Inverunders in Earthquakes in Bergal and Italy, 186, p. Parthquake tooks in Italy
and Australia, R. I. J. Pillery, E R S, 206, 272, the Inveris and Standard and the Australia and Parthquakes in
San Shirodor and the Australia
(197, 198), p. Earthquake at Bournemouth,
Ilemy Ceul, 64, Foucault's Pendulum in relation to, 326

Henry Cecil, 614
Earthworms, Identification of Templeton's Bittish, Rev Hilderic

Earnwordma, undernation of Temperion's Dillada, key Hilderic Friend, 473 Dimon's Visitor's Companion to, 388 Eclipse of June 6, 1891, Partial Solar, M Perrotin, 168 Edinburgh, the 1892 Visit of the British Association to, 161 Edinburgh Royal Society, 119, 166, 191, 263, 310, 359 Edinburgh Proposed Informal Congress on Scottish Higher

Edinburgh University, Summer Graduation Ceremony, 323

Edinburgh University, Summer Graduation Ceremony, 33; Edination Technical, and County Councils, 324, Svr I 11 Farers, 6, J. C Buckinster, 585, the Technical Education Technical, 321; Lord Harmington on Technical Education, 324; Technical Education in the South Eastern Counties of England, 39, Technical Education for Farers, Farrers, and Engine Dirvers, John L. Winter, 330, the City and Guldid of Lordon Institute and Institution in Woodwork in Guilds of London Institute and Instruction in Woodwork in Publie Elementary Schools, 337, the Progress of Technical Education, 351, New Physics and Ellectrical Engineering Department at Manchester Technical School, 437, Technical Grant Control of the Control of the Control of the Control for Instructors, 653; Alterations in the Science and Art Pricetory, 40; University Extension Scheme, 40, Eighteen Vears of University Extension, 52; Education in India, 67, 83; Secondary Education in Scotland, 467; Educational Agricultura, Dr. W. Fram, 137, University of Uniford and Agricultura, Detaction in Science, 40, 22, Increased Accom-ford Control of Control of Control of Control of Control Scientific Measurement of Children with Respect to Educa-tion, Rev., 14, Scientific, Approximents to 100, Rev. 14, Scientific, Approximents

Fdwards (Frederick E.) Collection of British Oligocene and Eocene Mollusca in the British Museum, Systematic List of, Richard Bullen Newton, 610

Richard Bullen Newton, 610 Egmins (D.), Observation of Passage of Mercary across Sun's Dick, May 9, 1891, 119 Dog in Anzient Egypt. Mercary in April 1992, 119 Dog in Anzient Egypt. Mercary in April 1992, 119 Dog in Anzient Egypt. Mercary in April 1992, 119 Dog in Anzient Egypt. Mercary in April 1992, 119 Dog in April 19

on, 151 Fhrlich (Prof), Koch's Present Views regarding Tuberculin,

Fhrligh (Dr), Immunity, Natural and Acquired, 422

Libolton Cave near Skipton, B A Report on, 480 Elbolton Cave near Skipton, B A. Report on, 480. Fleetricity. Hertz's Experiments, 12, 31; Electricity in the Physical Department at Bangor University College, 18; Intensity Colls, how made and how used, by "Dyer," 28, Production of Solid Carbon Dioxide, Dr. Haussknecht, 43; Earth Currents, the Electric Railway and the Royal Observa-

Farth Currents, the Electric Railway and the Royal Observa-tory, William Filts, 127, the Theory of Electro-dynamics, J Larmor, 139, Blakeley's Method of Measuring Power in Transformers, Prof Perry, F. R. S., 142, New Model of Copper Oxade Batteries, F. de Lalande, 144; Quadrant Hetchneters, W. F. Ayton, F. R. S., 1 Perry, F. R. S. and F. K. S., 264, Dielectric Toppetites of Mice at High Tempera-tries, E. Boury, 165, Discharge without blerowick though F. K.S., 262., Detector Projectives of Nuclear Lingon tempera-tures, L. Bouty, 163, Duschange without Electrodes through Gases, Prof. J. Thomson, F. K.S., 187, Experiments on Luquel Electrodes in Vacauum Tules, C. Chree, 191. Electri-val Evaporation, Wm. Crookes, F. R.S., 212, Electrolysus of Hartum Chloride, C. Limil, 216, the Pormation of Solity, a Contribution to the History of Lifections, H. F. Armstrong, FR S, 287, Papers on Electrolysis at the Meeting of the British Association, 454, Conversations of the Institution of Brush Association, 454, Conversations of the Institution of Electrical Engineers, 341 Study of Plant Cell, from Chemical Point of Vicw, 1, of 11 Roberton, 236, 11, 11 E-Amationg, 18 N, and 6 11 Roberton, 237, Altennice Amations, 18 N, and 6 11 Roberton, 237, Altennice Memory Power, 19 N, and 6 Property of Power of Po F. K. S., and I. Mather, 201, the Untervation of Atmospheric, Herren Eblert and Genet, 281, "Fol Pronacra on Maxwell's Electro magnetic I herone, Prof. A. Gray, 296, Electric Resistance of Colsalt, Prof. Knott, 311; the Relative Cost of Electricity in London and Ellewhere, M. Hushtmann, 234, the Origin of the New Electrical Light, 327, Proposal State and Petre's New Electrical Light, 327, Proposal By Sir I dward Waltin to place Electric Light on Snowdon, 332, Electrical Standards, 417, a Handbook, for Working Electrical Engineers, John W Urqubart, 586, the Report of the Board of Trade Committee on Electrical Standards, 417, Electrical Standards, 424, an Introduction to the Mathematical Through of Electricity and Magnetism, W. T. A. Emitage, 443, Electrical Exhibition, Crystal Palace, 450, 597. Proposed International Conference of Electricians at Chleago Ashabition, 49, 55, International Electro-Technical Congress, 450, Flectric Observations on Sonablick, Herren Elster and Cestel's, 425, Prof. D E. Jones on Electric Congress, 450, Flectric Observations on Sonablick, Herren Forces of Various Alloys, 455; Dampening of Occiliations in Iron Wire, John Trowbridge, 463, Frankfort International Flectrical Echibition, 494, 521, 524, 515; Prof C Forbes on Electric Motors, 510, Electric Transmission of Power, Marries and General Electrical Signaling, 575
Marries and General Electrical Signaling, 575
Ellacott (Capitan Was), a Comet observed from Suaries of Capitan Was), a Comet observed from Suaries Capitan (Fig. 1), F. R.S. Earthouge Shocks in Islaw and

Ellery (R. L J , F R.S.), Earthquake Shocks in Italy and Australia, 272 Elliott (Edwin Bailey), proposed Fellow of the Royal Society,

Ellis (William) Earth Currents, the Electric Railway, and the Royal Observatory, 127; Comparison of Thermometrical Observations in Stevenson Screen with same on Revolving Stand at Greenwich Observatory, 239

Elster (Herr), the Observation of Atmospheric Electricity, 281 Elster and Geitel (Herren), Electric Observations on Sonn-blick, 452

bluk, 452
Embryology Pyenogonids or Sea-Spiders, 49
Emin (Pasha), Ointhology of Lake Victoria Nyanza, 87
Emmerich (Prof.), Immunity, Natural and Acquired, 421
Emmons (S. F.), a Geological Excursion in America, 182
Entinge (W. T. A.), an Introduction to the Mathematical Emmons (S. F.), a Geological Excursion in America, 182 Emtage (W. T. A.), an Introduction to the Mathematical Theory of Electricity and Magnetism, 443 Encke's Comet, c 1891, 355, Dr Backlund, 438 Endowment of Revenech in France, MM Cahours and Janssen,

Energy, on some Test Cases for the Maxwell-Holtzmann Doctrine regarding Distribution of, Sir William Thomson.

Electrical Engineers, 231, Institution of Mechanical Fn

Electrical Engineers, 331, Institution of Mecananca ran Righesen, 333 game, Let, George, Ville, 517 Entounology, the Fostil Insects of North Auterna, with Notes on some European Speces, Samend II Swalder, R Lydel-ker, 1, the Locar, in India, 18, Entomological Society, 55, Spender, 120, the Blow-69, IP. Thompson Lowes, 123, Redevelopment of Lost Tumbs in Insects, John Watson, 163, Redevelopment of Lost Tumbs in Insects, John Watson, 164, November 1 even and Antenna in Bettler, W. Bitson, spencer, 120, the Blow-by, R I hompson Lowie, 125, Redevelopment of Lost Inius in Insects, John Vatcon, 161 Supernauerary Logs and Antenna in Beetles, W Batcon, 183, Rearrangement of the South African Museum Collection of Legidopters by R. Innens, 207, the United States and Legidopters by R. Innens, 207, the United States Lammous Insects in Astrollana Bash, Heary Deane, 231, Astronituting Bug, Bir Wroughton, 262, Insect-light Nidded by Thodoction-Gorgethy, M Marey, 262, Locoptens W. A. Wagner, 350, the Song of the Clenda, 437, Agricultural Entonology, Reugnation of Miss Ormetod, 451, 538, Minnery in Synder, E Heckel, 451, Loone Difficulties excit and Flowers, G. F. Sott Blinte, 488, Minner and Control of the Control

Diseases, and their Relation to our Knowledge of, Dr Lewis

Sambon, 486
Epilobum, the Species of, occurring North of Mexico, Dr

Epitonum, inc. opened. or, Trelease, 195
Erratics, the furthbutton of, in England and Wales, Rev Dr. Erpitics, the Startibutton of, in England and Wales, Rev Dr. Expin (Rev Dr. T. F.) Photo Stellar Spectra, 133, Two New Variable Stars, 578

Varsable Stars, 578
Estex Cousty Council and Technical Education, 324, 548
Ether, Clock for pomiling out the Direction of the Earth's
Orbital Motions in, Prof Oliver J Lodge, F. R.S. 218
Ether of Space, on the Functions and Nature of the, Prof. F.
E. Nighber, 471
Ethers, the Raic of Formston of Compound, N. Menschutkin,

Ethers, the Mate of Formation of Compount, N. AREBLERISE, Electrice on the Science of Ethnography, Dr. Daniel G. Brinton, 124 American Ethnological Expedition to Harbord, 185; Manners and Cantons of Sins Sixter, W. R. Illiler, 137, the Cantons of Sins Sixter, W. R. Illiler, 137, the Abedganes of the Maley Tennisals, 600. Ethyl Osde, an Attempt to Getermine the Adabatus Relations Office, 186; Manuary, P. R.S., Sand E. P. Fermin, O. D. O. D.

Encalypts, the Classification of, 41
Encalyptus Branches, Green, as a Disinfecting, Baron von
Mueller, 353; J. Brendon Curgenven, 445

Euchd, Books I - II, Rider Papers on, Rupert Deakin, 76 European Botany, Vol. 1. K. Richter, J. G. Baker, F. R. S.

European Wenther Charts, Cartain C. H. Seemann on, 41 Evaporating Power of a Climate, Determination of, Dr. Ule. 137

Evaporation, Electrical, William Crookes, F. R. S., 212 Evaporation, Water, in Sun and in Shade, Signor Batelli's

Experiments on, 136

Ewerctt (Prof. FRS), Illustrations of CGS System of Units, with Tables of Physical Constants, Prof John Perry,

Units, with Tables of Physical Constants, Prof. John Perry, F. S., 489.

Location of Algebra, on the, Prof. E. W. Hyde, 470.

Evolution, the Classification of the Taincata in Relation to, Reviews, Prof. 1998.

Evolution, Cosmical, a. New Theory of the Mechanism of Nature, Even McLennan, 32.

Fountionary Cassignton, Key John Gerard, S.J., Prof. Meldola, F. R. S., 441.

Eveng (Prof. J. A., F. R. S.), the Molecular Process in Magnetic Inductions, 656.

Exhibition, the Coming Chicago, 258, and the McKinley Bill, Exhibition, Grand Cheege, 255, and the Meximity Bill, 351, Mines and Mining Department at Cheege, 476; British Electrical Display at the, 575 Exhibition, Contemplated Victorian, 352 Fubilition, Crystal Valace Flectrical, 450, 507 Libilition of Effic Victoria Cholinahipa, 351 Exhibition of Photographic Society of Creek, Britain, 231

Expedition Afoot to the North Pole, Lieutenant Peary's Projected Botanical, 231 Papedition, Baror Nordenskield's Proposed Antarctic, 231

Expedition, the Heilprin Greenland, the Accident to and Position of Lieutenant Peary, 475

Expedition to Labrador, American Ethnological, 185 Expedition to Laberia by O. F. Cook, Projected Natural History, 548

Expedition to Pahang, Straits Government Scientific, 112

Expedition, Pilcomayo, J. Graham Kerr's, 135
Expedition, Scientific, for Investigation of Suth Maryland, 208
Expeditions to the Chin Hills and Bhamo Country, Projected, ren.

Fryerimental Physics Liquids and Gases, Prof W Ramsay, FRS, 274 Experimental Researches on Mechanical Flight, Prof S P I angley, 277

Face, the Growth of the, Prof G M West, 325 Fairyland Tales of Science, Prof J G McPherson, 5 Faraday Centenary, Lord Rayleigh, F R S, 178

Faraday (Michael), a Souvenir of, 230 Farrer (Su T II, Bart), County Councils and Fechnical

Education, 6 Patio (Vietor), Faune des Vertébres de la Suisse, Dr Albert

Gunther, 269
Faye's (M) Theory of Cyclones, Henry F Blanford, F.R.S., 348

1948
Fayer (Sir Joseph, F.S.A.) Elected Member of the Royal Italian Society of Hygiene, 323, Elected Associate of Para-Academy of Medicine, 331, Address in the Section of Pre-view Medicine at the Congress of Hygiene, 36

Guignard, 168

Federated Institution of Mining Engineers, 500

Felkin (Dr Robert), on Acclimatization, 508
Fermor (B L), on Government Timber Tests, 471
Ferns, Hand-book of the, of Kaffraria, T R. Sim, J G

Baker, F.R. S., 75

Ferriel (Prof Wm) - Death of, 500, Obitunry Notice of, 527

Ferrier (Dr David, F.R. S.) - the Cronnian Lectures on Cerebral Localization, 292, Presentation of Cameron Prize

to, 351 Festing (General, F.R.S.), Grenter Sensitiveness of Eye to Different Colours, Apparatus to show the, 187
Ficheur (M), the Rocene Formation of Algeria, 264

Field Naturalists' Club of Victoria, Excursion to Kent Islands, 476

Finger Marks, Method of Indexing, Francis Galton, F.R S.,

141
Finger Prints as a Means of Identification, Francis Gulton, F.R.S., 187

Finkelnburg (Dr.), on the Influence of Soil on Consumption.

370
Fire-Prevention , the Society of Arts Fothergill Gold Medal for,
135; 1000 Lire Gold Medal offered by Bologna Academy for
Memoir on best Means of, 301

Fire Prevention, the Society of Ant Fothergall Gold Medal for, 1353 1000 Life Gold Medal fores by Bologna Academy for Firs and Plates of Japan, Dr. Maxwell T. Masters, F. R. S., 339 Fischers (H.), Development of Liver of Nudsharachastes, 144 Fish. some Remarkable Catches of, 19, the Destruction of, by Front, F. F. Tayer, 3.1, Fossil Tain of the Scandars wan Dr. Albert Gunther, F. R. S., 269, J. T. Cunningham on the Raperduction of the Pitchers, 481, J. T. Cunningham on the Rape and Growth of Age of Sexual Maturity in Fish, 483, under Gunther, F. R. S., 269, J. T. Cunningham on the Rape and Growth of Age of Sexual Maturity in Fish, 283, under the Company, 481; Fr. G. Howes on the Gold of Fishes, 483, United States Fish Commission Reports, 562, Oyster Tshefreis, M. Fryer, 323, Fish Commission Reports, 562, Oyster Tshefreis, M. Fryer, 323, Fishers on the Gold of Fishes, 483, Californeoud on Sea Fisheries, 481, the Baltimore Fishing School and Irish Fisheries, 469.

Fisher (Fred W. R.), Lowestry in North America, 60

Fisher (Fred W. R.), Lowestry in North America, 60

Fisher (Fred W. R.), Lowestry in North America, 60

Fisher (Fred W. R.), Lowestry in North America, 60

Fisher (Fred W. R.), Lowestry in North America, 60

Fisher (Fred W. R.), Lowestry in North America, 60

Fisher (Fred W. R.), Lowestry in North America, 60

Fisher (Fred W. R.), Lowestry in North America, 60

Fisher (Fred W. R.), Lowestry in North America, 60

Fisher (Fred W. R.), Lowestry in North America, 60

Fisher (Fred W. R.), Lowestry in North America, 60

Fisher (Fred W. R.), Lowestry in North America, 60

Fisher (Fred W. R.), Lowestry in North America, 60

Fisher (Fred W. R.), Lowestry in North America, 60

Fisher (Fred W. R.), Lowestry in North America, 60

Fisher (Fred W. R.), Lowestry in North America, 60

Fisher (Fred W. R.), Lowestry in North America, 60

Fisher (Fred W. R.), Lowestry in North America, 60

Fisher (Fred W. R.), Lowestry in North America, 60

Fisher (Fred W. R.), Lowestry in North America, 60

Fisher (Fred W. R.), Lowestry

Influence of Advances influence of Suspended Matter in, Prof Stokes, F.R. 5, 263
Flammarion (C.), Apparent Total Disappearance of Jupiter's

Satellites, 311

Flesh, Organic Bases in the Juice of, G. S. Johnson, 117 Fletcher (Thomas), Rain Gauges, 371 Flight, Experimental Researches on Mechanical, Prof. S. P.

619
Flowers, our Country's, W J Gordon, 247
Fluorine, Action of, on Phosphorus Trifluoride, M Mossan, 186, 333, 622, A E. Tutton, 333
Fluorine, Further Researches upon the blement, A E Tutton,

622

Foerster (Dr), Volatile Carbonyl Compounds of Platinum, 530 Fog. a Method of Counting Water-Particles in, John Atthen,

119
Folk-lore Congress, International, the, 527
Folk-lore of the Hungaran Gyptes, Dr H, von Wilslock, 630
Folk-lore, the Manesana, Studies in their Anthropology and,
Dr, K. H. Codrington, 61
Folk H, Codrington, 61
Folk Polythology, William Durham, 40
Ford Physiology, William Durham, 40
Forbes (Poff G), on Ekerter Motors, 510
Forms and Districtation. From Med. appagn, 108. Prof Oliver

Force and Determinant Evan McLennan, 198, Prof Oliver J Lodge, F R S, 198, 272, Prof C Lloyd Morgan, 249, 319, Edward T Dixon, 249, 319; Rev T Travers Sherlock,

320, D Wetterhan, 320 Force and Motion, the Laws of, John Harris, 443

Force and Motion, the Laws of, John Itarris, 445
Forestry in Roth America, Prof W. R. Enher, 60
Forestry, the Teaching of, Willian Schlich, Sir D. Brandis,
F.R.S., 265
Forestry, on Government Timber Tests, B E Fermor, 471

Forests and Air-Temperature, 68
Forty Years in a Moorland Parish, Rev J C Atkinson, 122
Fossil Fish of the Scandinavian Chalk, 117

Fossi I reset of North America, with Notes on some European Species, Samuel H Soudder, R Lydekker, 1 Fossii, Prodystata centrodos, H Trautschold, 359
Foster (Prof. G Carey, F.R.S.), the Proposed Albert Univer-

sity, 223
Fourteenth Century Weather Record, 538
Fox (Dr. L. W.), Rarity of Colour-Blindness in Savage Races,

Fox's Head for Country, the, J Harting, 452 France: Endowment of Research in, MM Cahours and Janssen,

17; French Accent, Dr. Pringsheim, 67; French Meteorological Society, 112, New Natural History Stations in France, 135, French Academy's 20,000 france Prize voted to Elisée Reclus, 161; the Propo ed Law on Universities, 185, French Ausociation for the Advancement of Science, 250, 499, 598, Lighting in France, the Increase in the Consump-tion of Gas, Electricity, and Petroleum, during the Last Decade, 282, the Protection of Prehistoric Monuments in,

232; the Destruction of Small Birds in, 390
Frank (Dr J.), a Case of Periodical Skin-shedding, 477
Frankfort, Acclimatization of Japanese Lacquer tree at, Prof.

Rein, 500 Frankfort International Electrical Exhibition, 494, 521, 542;

Frankfor International Electrical Echibition, 494, 521, 542; some Notes on the 615, proposed Follow of the Royal Society, 15, Manuel Paratipu d'Analyse Bactériologique des Eaux, Dr Moyuel, 513
Fream (Dr W.) Technical Education in Agriculture, 137
Fream (Dr W.) Technical Education in Agriculture, 137
Fream (Dr W.) Technical Education in Agriculture, 137
Fream (Cl.), the Insectivorus Birds of Victoria, 162
French (Cl.), the Insectivorus Birds of Victoria, 163
French (Rev. Hildere), Identification of Templeton's British French (Rev. Hildere), Identification of Templeton's British

Friend (see Indexent), decinination of temperous British Farthsomy, 25 ew South Wales Bettle (fam. Carculonidæ) as an Example of Protective Coloration, 576 Frost Penometon, Unusual, A. H. White, 519 Fryer (Mr.), Oyder Disease and 48 Remeller, 233 Fursibe, [alklonowsky Lesellichth, 325, Astronomical Prize

offered by, 325

Fusing and Boiling Points of Compounds. Dr Gustavas Himrichs, 174

Galton (Sir Douglas, F.R S.), Address at the Congress of Hygiene, 362

Hygene, 362
Galton (France, FR 5) Method of Indexing Enger marks, 141, Finger-prints as a Means didmitteation, 187, Meteroological Phenomenon, 294
Gwedner (Walter, FR th., Water Law, 198) Phints, Pheno Carnier (Walter, FR th., Water Law, 198) Phints, Pheno Carnier (Juley, Transport of Metallic Lion and Nickel by Carhon Moocaide, 336
Garrier (Juley, Transport of Metallic Lion and Nickel by Carhon Moocaide, 336
Garrior (Dr.) on Human Remans found in Yorkshire, \$11
Gas [ets under Pressure, Combustion of R W Wood, 189
Gas Mixtures, the Slow Combustion of Feploises, Krause and Meyer, 354

Gases in various Geological Phenomena, Probable Rôle of, M Daubrie, 360
Gases, on Double Lines in the Spectra of, Dr. Johnstone

Gases, the Foundation of the Kinetic Theory of, V., Prof. Chrystal, 310

Chrystal, 310
Genes, Liquaks and, Prof W. Ramsay, F. R. S., 274,
Gautter (Henry), Action of Nitric Acid upon Iron, 216
Genes Char Christald, F. R. S. 1) on the Discovery of the Archael
Genes of the North-West Highland of Scolland,
Genes of the North-West Highlands of Scolland, 450
Genet (Herry), the Chiercision of Aimospheric Electricity, 287
Genet and Elster's (Herren) Electric Observations on Sonn-

Genoa, projected International Botanical Congress at, 598
Geo-botanical Notes on Flora of European Russia, D I

Geo-botanucal Notes on Flora of European Russia, D I Livitori, 390 (graphical Society, see Royal) Major Chaule M. Macdonald on the Benué and the Kibbé, 46, the Miranais Expedition, 65, Alexander Melhee on the Expolation of Central Austrias, 67; Physical Geography and Geology of Central Austrias, 67; Physical Geography and Geology of Kerri's Pictomaye Expedition, 135, Major Hodday's Explorations on the Upper Irawaddy, 137; Aerone East Africas Chicaley, and Account of the First Ascent of Kullinasijano, Gladers, an Account of the First Ascent of Killmanjaro, Dr Hans Meyer, 49; Contemplated Geography of the Clyde Sea at Laverpool, 16; Physical Geography of the Clyde Sea Karrendel Alp, A. Robhpist, 23; the Huttory of Con-merce in England, H. de B. Gibbins, 223; the Northern Limits of the Black-Earth Steppe Region of East Russis, Korrchinsky, 326; Record of a Joungsy in Northern Cores, Mr. Campbell, 333; the Banses of Travel, W. Fraser Rasi,

247; the Yoraba Country, West Africa, Alvan Millson, 209; a Journey in Gazaland, South East Africa, Denis Doyle, 209, Proofs that Asia and America have been Recently Connected, Proofs that Asia and America have been Recently Connected, Emile Blanchard, 355; the International Goographical Con-gress at Berne, 355. Prance of Monaco's New Yacht for Study of the Sea, 359, the Field of Goography, F. G. Ravenstein, 423. Exploration of Greenland, 436, tits Nanuyak Islanders, Ivan Petrol, 477, Mrs. French shellon on East Africa, 308, JP. Robert Felkin on Acclimatization, 308; Colonel Hollech on the Application of Injian Geo on East Afrea, 508, Dr. Robbert Felkin on Acclimatization, 505 Colonel Indiction the Application of Initian Geogos Colonel Indiction the Application of Initian Geoon out Ordinance Survey, 508, J. Scott Kilte on Geographical Education, 509, Rivs Nasian Geographical Society's Medial Awartis, 508, Br. Joseph Thomson's Faplorations in Colonel Col Diffusion of Three Distinct Forms of Litanium Oxide in Cretaceous Strata of Notthern France, Dr B Roszeboom, 144; Geologists' Association, a Record of Excursions made between 1860 and 1890, edited by Thomas Vincent Holmes Cheming and Catskill on the Eastern Side of the Apparatoman Basin, Prof J J Stevenson, 471. a Preliminary Report of Observations at the Deep Well, Wheeling, W Va, William Riallock, 472. Prof Boyd Dawkins, F K S., on the Chan-nel Tannel Boring and the Discovery of Coal, 469, W Topley, F R S., on the Origin of Petroleum, 479, Sir Hallock, 472., Prof. Hoyel, Dawkins, F. R.S., on the Cham-el Tunnel Borning and the Discovery of Cond., 469. W.
Archibald Gelke, F. R.S. Grupa of Petroleum, 479. https://dx.discover.ic.com/dx.discover.i

Antiquity of the Last Glacal Perod, N. S. Shaler, 529, Geological Formations exported in Bridgwarte Kullway Cattings through Folilen Hills, J. P. M. Clarke, 529, Cattings through Folilen Hills, J. P. M. Clarke, 529, F. G. Bonney, F. N. S., 527, South Irlain Volcinoce, Dr. Johnston-Lavis, 530, the Rapakiws, J. J. Sederholm, S. Geology of the Muricer Hands, I. H. Cooke, 550-486, Geology of the Muricer Hands, I. H. Cooke, 550-486, Geology of the Muricer Hands, I. H. Cooke, 550-486, Geology of the Muricer Hands, I. H. Cooke, 550-486, Geology of the Muricer Hands, I. H. Cooke, 550-486, Geology of the Muricer Hands, J. H. Fulwards, Collection of Systemus Last of Friedrick F. Fulwards, Collection of Systemus Last of Friedrick F. Fulwards, Collection of Wassen (Natural History), Karbard Ballien Newton, 610-6, Memonals of John Cann, being some Account of the Cromer Forcet Bels and in Stonel Mannania, Gra Antiquity of the Last Glacial Period, N S Shaler, 529, Geometry of Conics, Dr. Taylor's Llementary, 517 Geometry of Position, R. H. Graham, Alex Larmor, 195

Gerard (Rev John, S. J.), Science or Romance, Prof. R. Meldoli,

FRS, 441 German Naval Observatory, Hamburg, Catalogue of the

Library of, 318 German Ornithological Society, Annual Meeting, 39 German Society for the Facouragement of Industry, Prizes, 66 Germany, the Heavy November Rains and Floods in Prof Hellmann, 206

Genez (D.), Application of Measure of Rotatory Power to Determination of Compounds of Aqueous Solutions of Mannite with Veid Molyblates of Soda and Ammonium,

Chizeh Museum, Mummies, Papyri, &c, at, 66 Cilbins (H. de B.), the History of Commerce in England, 222 Gibbs (Prof. J. Willard), Quaternions and the Ausdehnungs

Gildirist (Percy G), Proposed Fellow of the Royal Society, 15 Gill (C. Haughton), on Diatoms, 23 Gill (Dr. David, F.R.S.), an Astronomei's Work in a Modein

Observatory, 603 Girafle and its Allies, 524 Girls, the Technical Education of, 185

Glacial Epoch, Relies at Kelley Island, Ohio, 207 Glacial Perod, Antiquity of the Last, N S Shaler, 529 Glacial Plenstocene Deposits, Classification of the, Prof T C Chamberlin, 504, Prof T. McK Hughes, 504, Mi McGee,

504
Glaciers discovered in Caucaus, New, 452
Glaciers, Snow-ships of the Kazbek, Dr. Woelkof, 600
Glaciers, the Variation of Alpine, 389
Gladstone (Dr. J. I., F.R.S.), Molecular Refriction and
Dispersion of Various Gulstances in Volution, 215 (dazebrook (R. I., F. R. S.), on the Resistance of some Meichie Standards, 94

Standards, 94. Caseline from Nova Scotta, L. V. Pirson, 310. Coeffining from Nova Scotta, L. V. Pirson, 310. Coeffining Sanis Radiation of Heat, 468. Coefficient Sanis Radiation of Coefficient Sanis Recentive Institute, Opening of, 280. Coefficient Sanis Recentification of Coefficient Sanis Recentification

Goodled (Prof. Geo. 1.), some of the Possibilities of Francounce Botany, 409, 53 country's Flowers, 427 Goog (II), broad-additate, 488 George (II), broad-additate, 188 George (III), broad-additate, 188 George (II), broad-addita

Grapes, Oranges, etc., the Cuttivation of a Martinals of Graphical Statice, by Luigi Creationa, translated by Prof Thomas Huddon Beare, 21
Gratal (Lieutenaut), the Marcograph in Pola and Trieste Harbours, Goo Gravitation

mination by means of Common Balance of, J. H. Poynting,

militation by means or Common Indiana. Fig. 7 R.S., 198
Gravitation Systems, Absolute and, Preferenck Sinte, 445
Gravitation Systems, Absolute and, Preferenck Sinte, 445
Grav (Prof. A.), Maxwell's Electron magnetic I theories, 296
Gras, Study of Remarkable Series of Haistorms at, Prof.

Prohaska, 233 Greece, Mountain-Climbing in, Dr. Philipson, 599

Greece, Monatian-Clambaga in, Dr. Philipson, 509
Greek, the Stury of, at Cambridge, 1989 of the Arr, 388
Greety Lesternant A. W.), the Geography of the Greedy, 1989
Froi Greeville A. J. Colo, 25, an Introduction to the
Study of Petrology, by Dr. Frederick II. Hatch, 25
Green Ray, the, C. Mosiya, 33
Green Ray, the, C. Mosiya, 33
Greenhall (Prof. A. G., F. R. S.). Differential and
Calculary, 107. Solutions of Examples in Elementary Hydro
statics, W. H. Benant, F. R. S., 34
Greenhall, S. Greenberg, 1989
Exploration of, 436, the Hellupin Exposition, the Academi,
to, and Position of Leutenant Peary, 475
Greenwick, a Prime Mendian, Arquinesty Squins' Adoption of
Greenwick, as Prime Mendian, Arquinesty Squins' Adoption of
Greenwick, as Prime Mendian, Arquinesty Squins' Adoption of
Greenwick, as Prime Mendian, Arquinesty Squins' Adoption of

Greenwich, as Prime Mendian, Argunien's squarst Adoption of, M. Tondon, 19, Farth Curries, the Flective Railway, and Wintston of the Royal Observatory, 129 (George V) W. the Foasil behinded of Malta and their Evidence on the Correlation of Maltace Rock, 31 (Evidence on the Correlat

dation, 168

dation, 168
Guillaume (Ch. Ed.), Alum Solution, 540
Guillaume (Ch. Ed.), Alum Solution, 540
Guillaume (Rev. John T.), Physiological Selection and the Different
Meanings guest to the Term Interfutive, 29
Gunn (John), Memorials of, being some Account of the Croner
Forest Bed and its Forsti Marmalia, 612
Guinher (Dr. Albert), Faune des Vertelacs de la Susse,

Victor Fatto, 269
Guntz (M) the Sub chloride of Silver, 120, Action of Light on Silver Chloride, 288

on naiver Chionde, 288
(nyan (J. M.), Education and Heredity, 292
(Guye (J. A.), Determination of Molecular Weights at Critical
Poilit, 144
(ypnes, Hungarian, Dr. II. von Whislocki on the Handscrafts
of 620

Haddon (Prof. A. C.), Art and Ornament in British New Guinea, 188 Hail in Process of Formation, Observation of, Prof. Tosetti, 113 Hatlstorm of May 24, B J Hopkins, 224
Hailstorms at Graz, Study of Remarkable Series of, Prof.

Prohaska, 233
Hairs (L.), Linamarine, a New Glucoside from Linam unita

Itssinum, 312
Hale (Prof. G. H.), Photography of Solar Prominences and

Hale (170), G. 11.), Hotography of Soler Frommences and their Spectra, 391.
Haldes of Potassium, Ch. Blater, 23.
Hall (J. W.), the Habits of the Kingfisher, 502.
Halliburton (Dr. William Polumon), Proposed Fellow of the

Halthurton (Dr. Walliam Polinicon), Proposed Fellow of the Royal Society, 16 Preliminary Report of Observations at the Deep Well, Wheeling, W \(\frac{1}{2} \), 472 Haloid Salts, the Formation of, 455 Halmilton (Prof.) on the Milk and Meat of Tuberculous

Hamming 1. 10. Animals, 397

Hands (A. J.), Curtons. Case of Damage by Lightning to Church
at Needwood, 239

Hankin (E. H.), Immunity, Natural and Acquired, 421

Hankow Varnsh, 163 Hann (Dr. J.), Studies of Air Pressure and Temperature on Summit of Sonnblick, 112 Haussen (C J), Proposed International System of Weights and

Measures, 41 Microsites, 41
Hardness, the Measurement of, in Transparent Bodies, Prof Auerbach, 282
Harkness (Prof W.), the Solar Faral'ax and its Related Con-

stants, 115 Harmer (S. F.), Nature of Excretory Processes in Marine

Polyzon, 143

Harrington (B |), the so called Amber of Cedar Lake, 584
Harrington (Prof M. W.) How can the Weather Service best
Promote Agriculture?, 165, appointed Chief of United

States Weather Bureau, 280
States Weather Bureau, 280
Harns (John), the Laws of Force and Motion, 443
Harns (W. H.), Remarkable Instance of Frugality in Bees

1350 (W Jerome) · Flementary Chemistry for Beginners, 102 , Guide to Examinations in Physiography, and Answers

to Questions, 613
Harting [J], the Pro's Head for Country, 452
Harting (m [Tord), on Technical Education, 234
Harting (Frof W N, F R S) Laquid Prems, 273, a Rare Phenomenon, 614

Phenomenon, 644
Illatog (Fro Maccos M) - Arc Scellings of Homeonalin future specially Variable, 274, on Psotoplasmic Rejavenescence, 485, a Diskolyum Wennammen, 613
Illareys, Discovery, Dr. Diskinson, 597
Illareys, Discovery, Dr. Diskinson, 597
Illatogs, Proceeding, 11, an Introduction to the Study of Petrology, 1rof A II Internal, P. R. S. 25
Illationan, 164, bit Relative Cost of Electricity in London

Hauskanecht (Dr.), Production of Solid Carlion Dioxide, 42
Hauskanecht (Dr.), Production of Solid Carlion Dioxide, 42
Hawk and Spairows in New Zealand, T. W. Kirk, 529
Hawk haw (Sir John, P. R. S.), Death and Obituary Notice of,

Hay, Remarkable Rum of, 294 Haycraft (Dr I I:), Displacements of Heart and Cardiogram.

Haynald (Cardinal) Obstuary Notice of, 256, his Herbarium, Heart and Cardiogram, Displacements of, Dr 1 B, Haycraft,

167 Heat, Determination of Mechanical Equivalent of, C. Miculesco,

168 Heat moon Magnetic Susceptibility of Nickel, Liffect of, S.

Bidwell, F. R. S., 187 Heat, Sun's Radiation of, W. Coff, 468 Heavens, the Story of the, Su Robert Ball, 589 Heavende (Oliver), Proposed Fellow of the Royal Society, 16

Heckel (E.), Minnery in Spiders, 451 Heights of Auroms, 7 W Brekhouse, 541 Heiljum Greenland Expedition, the Accident to and Position

of Leutenant Pears, 475
Hellmann (Prof G.) on Parometric Observations, 66, Meteoro logische Volksbucher, 185, the Heavy November Rains and

Floods in Germiny, 206

rioods in Germiny, 2000 Helodiema, Matouny of, G. A. Boulenger, 44 Helodema, Anatomy of, G. A. Boulenger, 44 Himerachin, Julia, are Seedlings, of, Specially Variable, Prof. Marca M. Hartog, 274 Hemsky (W. Botting, F. R. S.), the Flora of Diamond Island,

1.75 Henslow (Prof. George), I fritori Reasoning, 55 Hepworth (1 C.), Evening Work for Amateur Photographics, 52 Herdin in (Prof. W. A.) the Classification of the Tumcata in

Herdinn (York VA 1) the Ussincition of the Luncata in Relation to Fouthon, 120. Coppoids as an Article of Food, Harday Co Adaptation, Prof. R. Mikidia, F.R.S., 28, 5, Frof Ceopg J. Romanes, F. R.S., 28, 55, Heredity and Fulcation, J. M. Guyan, 292 Hermite (H.), Goolger, Prontices, 102

Herte's Experiments, 12, 31 Hess (Dr.), Relative Merits of Different Kinds of Points for

Lightning Conductors, 550 Hewett (Sir Prescott G, FRS), Death of, 184

Hewett (Kr) Treacut G. F R S.), Death of, 184 Hewett (Kr) on hipdemic Disease, 267, on Diphtheria, 369 Hewett (Kr) on Cittaconfluorissen, 71 Hewett (W.), Elementary Settors Lessons, 444 Heragram, Fascal's, 11 W. Richmond, 193 Heyman (D.), Symbictration of Lessons, 444 Heyman (D.), Symbictration of Lessons, 414 Heyman (D.), Symbictration of Sections in Gacial Deports at Hemos, 143, Subran and Devonan Rocks of

Deposits at Hendon, 143. Nituran and Devonan Rocks of Pembrock-hiret, 480 minual Life on a Coral Reef, 90 Hiskson (Dr. S. 1), and 11 Ji, 1s influenza Spread by Wind?, 165 Higgard (Prof. E. W.), on the Importance of the Abundance or Scarcity of Species in the Correlation of Strats, 506 Higgard (Prof. P. I.), Death of, 87 Hill (Dr.), Alex, by the National Home-Reading Union, 493

Hill (Rev. Edwin), Wells in West Suffolk Boukler Clay, 240 Hiller (W. R.), Manners and Customs of the Shan States, 137 Hime (Dr.), Tuberculosis, 397 Hinrichs (Dr. Gustayus), the Fusing and Boiling Points of

Hinrichs (Dr. Gustavus, the rusing and rooming to-Compounds, 174
Hobday's (Major) Explorations on the Upper Irrawaddy, 137
Hoffmann (G. C.), Examination of a Peculiar Form of Metallic Iron found on Lake Huron, 325

Hofmeister (Herr), the Swelling of Plates of Gelatine in Various Solutions, 326

Holdertic Region, Prof A. Newton, F R S., 197
Holden (Captain), Measuring Instruments used in the Proof of Guns and Ammunition at the Royal Arsenal, Woolwich, 578 Holden (Dr. Edward S). Colour Associations with Numerals,

&c, 223 Holder (Charles Frederick), Charles Darwin, His Lafe and Work, Prof R Meldola, F R S, 337

Holdich (Colonel), on the Application of Indian Geographical

Holdich (Colone), on the Application of Indian Geographical Survey Mulhods to Africa, 508
Holt (E. W. L.), Fish Caught in Cruise of 8.8 Finçal, 1890, off West Coast of Ireland, 282
Holt (Geor. Endowment of Chair of Physiology at University

College li Union, National, Dr Alex Hill, 493

Honey Der from Clover, the Flavour of Maltese, 502 Houey, an Artificial, 600

Honey dew, Bees and, P. M. Burton, 343 Honey dew, Bees and, P. M. Burton, 343 Honours, Birthday, for Men of Science, 111 Hooker (Str. I. D., F. R. S.), Elected Foreign Member of Bada-Pesth Academy of Sciences, 257 Hooker's Icones Plantarum, 498

Hopkins (B. J.), L.rratic Barometric Depression of May 23-29

and Hailstorm of May 24, 224

anti ransform of sagy 24, 224
Horticultural Society, see Royal
Hoskiws-Abrahall (Rev.]), a Beautiful Meteor, 162
Hospital and Ambulance Organization of the Metropolitan
Asylums Board for the Removal and Isolation of Infectious Diseases, Surgeon-General Bostock and Sir Vincent Bar rington, 486

Highes (Prof G B) on the Classification of Fishes by their Reproductive Organs, 483, on the Gills of Fishes, 483 Hubrecht (Prof A A W), a New Manimal from Sumatra, 468

Hufner (Herr), Biological Bearings of the Fact of the Stronger

Absorption by Water of Long than Short Light wave, 478
Huggins (Dr William, F.R.S.), Inaugural Address at the Cardiff Meeting of the British Association, 372
Hughes (F.), the Aco derivatives of B-Naphthylamin, 118
Hughes (F.) and Classification of the Glacial Plesto-

cent Deposits, 504
Hull (Prof. Edward, F. R.S.), the Geology and Physical Geography of North Syria, 99 Humphreys (N. A.), Results of Recent Census, 161

Hungarian Gypsies, Dr II von Wlislocki on the Handicrafts

of, 630 Huxley (Prof. T. H, FRS), Les Sciences Naturelles et l'Education, 272

Huxley Lahoratory for Biological Research, and the Marshall Scholarship, 627 Hyde (Prof. E. W.), on the Evolution of Algebia, 470

Hydrographic Department of Admiralty, 500

Hydrographic Department of Admiratty, 500
Hydrographic Exploration of Mediterranean, the Frigate Scilla fitting out by Italian Government for, 501
Hydrostatics, Solutions of Examples in Elementary, W. H. Besant, F.R. S., Prof. A. G. Greenhill, F.R. S., 341

Beant, F. R. S., Frof. A. G. Greenhill, F. R. S., 341 Hygene and Dicungraphy, International Congress of, 65, 307, 337, 344, 361, Vist to Cambridge, 361, Degrees Conferred, 361; Sir Douglas Caliton's Audiess, 362, Sir Joseph Payrer's Address in the Section of Preventive Medicines, 363, Surgeon-General Lumpfahm on the Mode of Preventing the spread of Epidemic Disease from one Country to another, 365, hygotophysical Lawson on the Communicability of

all its Relations, Prof. Buidon Sanderson, F. R. S., 393, Dr. Bang, 395, Prof. Arloing, 396, Prof. M'Fadyean and Dr. Woodhead, 396, Prof. Hamilton, 397, Prof. Nocard, Dr Woodhead, 396, Prof. Hamilton, 397, Prof. Nocard, 397, Dr. Hune, 397, Dr. Barlow, 397, Prof. Penonetto, 397, Dr. Metschnikoff and Dr. Koux, 397, Prof. Ehlich, 398, Immunity, Natural and Acquired, Dr. Koux, 419, Dr. Bachner, 420, E. H. Hankin, 421, Prof. Emirne, 422, Dr. Kissaste and Dr. Ebring, 422, Dr. Kiss Dr Ehrlich, 422, Dr. Kilasate and Dr. Benning, 422, Dr. Adami, 422, Dr. Klein, 422, Dr. Metchnikoff, 422, Alcoholism, Prof. Harold Westergaard, 484, on the Improved Hygicine Condition of Maternity Hospitals, Dr. W. () Priestley, 485. Measures adopted for the Prevention of Infectious Diseases, and their Relation to our Knowledge of Epidemics, Dr Lewis Sambon, 486, the Hospital and bulance Ouranization of the Metropolitan Asylums Board for the Removal and Isolation of Infectious Diseases Surgeon-General Bostock and Su Vincent Barrington, 486, Ueber General motock and Sti Vincent Darnington, 486, Uebel die Desinfiction, IP Pistor, 487, Dr. J. P. Williams Feetman on the Importance of Ventilation, 487, Illygene Her Rubner on Dry and Moss Temperature and Health, 66, Royal Italian Society of, Dr. Horner Thorne cleeted Corresponding Member, 351, on the Improved Hygranic Condition of Maternity Thospitals, Dr. W. O.

Priestley, 485
Hyvernat (Henri), Album de Paleographie Copte, pour servir a l'Introduction Paleographique des Actes des Martyrs de l'Egypte, 609

Ice Age, Sur R. Stawell Ball, F. R. S. on the Cause of an, 480 lee Age in North America, Prof. Wright, 480, G. Frederick, Wright, Porf. T. G. Bonney, F. R. S., 537 Wright, 1971 T. G. Bonney, F. R. S., 532 Lablywlogy some Remarkable Catches of Fish, 19, 1th. Destruction of Fish by Prost, F. F. Payne, 31, 1981 Caught in the Cruse of S. Frigard, 1890, off West Coast of Treland, 1 W. I. 101, 1829. Trol Methods on Marme Food fishes, 360, United States Fish Commission Reports, 552 change [J. P.), the Mineralia in Hollow Rilyolic Spherwlites, following. If P. J. the Mineralias in Hollow Rilyolic Spherwlites,

310

Identification. Finger-prints as a means of Francis Galton, FRS, 187 Identification of Templeton's British Earthworms, Rev

Hilders, Friend, 273 Immunity, Naturaland Acquired, Dr. Roux, 419, 10, Buchner, 420, F. H. Hankin, 421, Prof. Eminericli, 421, 10, Fhrlich, 422, Drs. Kitasato and Behring, 422, Dr. Adami,

422 , Dr Klein, 422 , Dr Metclinikoff, 422

Imperial Institute, 257
Imperial Physical and Technical Institution at Berlin, 151
Index Catalogue of the Library of the Surgeon General's Office,

U.S. Army, Dr. A. I. Myers, 563 India the Census of, 18, Indian Museum, Calcutta, 18, I du ndia the Census of, 18. Indian Minetim, Calcutta, 18. I 1st cation in India, 67, the Forecast of the Indian Ministon cation in India, 67, the Corecast of the Indian Ministon proved Weather Prospects in North-West India, 363, 186 tomad Survey of India, 347, Forecast yin India, 363, 186 Survey of India, the Cruse of the Interception, 187 A Alcock, Survey of India, the Cruse of the Interception, 187 A Alcock, on Indian Linguages, 511, Projected Expedition to the Clin Hills and Biasmo Country, 550, the Natural Nekation of Indian Court, 71. D A Cockerell, 50 Indiana, Larthquake in, 304

Indians of Nicaragua, the Amerique, J Crawlord, 502 Indigocarmine, Synthetization of, Dr Heyman, 114

Industrial Society of Mulhouse, 475 Industry, German Society for the Encouragement of, Prizes, 60 Infectious Diseases, Hospital and Ambulance Organization of the Metropolitan Asylums Board for the Removal and Isola-tion of, Surgeon-General Bostock and Sir Vincent Barrington,

486 Infectious Diseases, Measures adopted for the Prevention of, and their Relation to our Knowledge of Epidemics, Dr. Lewis

their Relation to our Knowledge of Epitlemios, Dr. Lewis sambon, 486
Inferthiny, Physiological Sciencian and the Dittereum Manning, Inferthiny, Physiological Sciencian and the Dittereum Manning, Inferthing Process Rev John T. Guleck, 29 Inferthing, Proceedings of Preds. J Brodie, 283, 11on R. Russell, 200, 514; J. Pr. Richard Saley, 514, Insectis, Aquatic, some Difficulties in the Life of, Prof. L. C. Mail, 457

Insects, Fosul, of North America, with Notes on some European Species, Sanuel II Saudder, R Lydekker, I Insects, Redevelopment of Lost Limbs in, John Watson, 163 Insects, the Flight of, Studied by Photochronography, M Marey,

264 Institute at New Cross, Opening of Goldsmiths' Company's Technical and Recreative, 280

Institute of Preventive Medicine, the National, 184 Institution of Civil Engineers, 119, 599 Institution of Mechanical Engineers, 20, 332, 574

Institution of Meenanteat Engineers, 20, 332, 574
Institution of Naval Architects, 305
Instruments in Just Intonation, Robt A 1 chfeldt, 519
Intensity Coils, How Made and How Used, by "Dyer," 28 International Agricultural Congress, 450

International Botanical Congress at Genoa, Projected, 598 International Conference of Electricians at Chicago Exhibition. Proposed, 450 International Congress of Analytical Chemists and Microscopists,

International Electro Technical Congress, 450 International Folk Lote Congress, the, 527, 548
International Society, an, Prof. W. II. Flower, F. R. S., 7

International boretty, an, Prof. W. 11. Flower, F. R. S., 7. International Neutrical Congress, 97.6

International Neutrical Congress, 97.6

Internationaler Archiv for Ethingraphic, 153, 599. Intonation, 19st. a. New Keyed Museral Internationaler Archiv for Ethingraphic, 153, 599. Intonation, 19st. a. New Keyed Museral International Continuation, 19st. a. New Keyed Museral International Continuation, 19st. 19st

Irish Fisheries, the Baltimore Fishing School, 549 Iron, Action of Nitric And upon, Henry Gautier and Georges

Total of Write Act upon, Frenty Gautter and Georges Charpy, 216

Iron found on Lake Iluron, Examination of a Peculiar Form of Metallic, G. C. Hoffmann, 325

Iron in Gold-washings about Berezowsk, Daubice and Meinier,

from in Gotte Washing a note to the State of the State of

Jrva and Steel Institute, 527, 548, Annual Meeting, 17, 42, Annual Autumn Meeting, 578, 107 Anderson, F R S, on the Constitution of Ordnance Factories, 578, Lopi. Holden on the Measuring Instruments used in the Proof of Gains and Ammunicing at the Royal Aremai, Woolwich, 578, Sir Amainnton at the Royal Arsenat, Woolweit, 579, 511
Henry Beasener on Rolling the Steet Sheets direct from
Molten Metal, 578, W. H. White on the Shipbalthing
Material at the Naval Fathouno, 579, W. D. Allen, Forg
ing Press, 579, Mr. Carulla on Cuitous Phenomena in
Melting Beasener Scraps, 579

Melling Bestener Seraps, 579
Iron-Carbon Ovide, 455
Iron-Carbonyl, Mond and Qunncke, 304
Iron-Carbonyl, Mond and Qunncke, 304
Irans addy, Major Hoblay's Explorations on the Upper, 137
Irragation, Egyptian, 145, 5 hr Colin Moncneff on, 151
Irragation, Egyptian, 145, 5 hr Colin Moncneff on, 151
Irragation, Egyptian, 145, 5 hr Colin Moncneff on, 151
Irragation, Egyptian, 145, 5 hr Colin Moncneff on, 151
Irragation, Egyptian, 145, 5 hr Colin Moncneff on, 151
Irragation, Egyptian, 145, 5 hr Colin Moncneff
Irragation, 150
Irragation, 150
Irragation, 150
Irragation, 150
Irragation, 151
Irragation, 150
Irra

Growth, 371 Italian Government, the Frigate Scilla fitting out by, for Hydro graphic Exploration of Mediterranean, 501 Italy and Australia, Earthquake Shocks in, R. I. J. Ellery,

F K.S , 272

Italy, the Recent Earthquakes in, Prof J P O'Reilly, 293 Italy, Severe Earthquakes in, 136, 161, 185 Italy South Italian Volcanoes, Dr Johnston Lavis, 530

Jackals and Jungle Cocks, 30 Jamrach (Charles), Death of, 450 Jansace (P. J. C.), on the Endowment of Research in France, 17, proposed Astronomical Observatory on Mont Itlanc, 446

446

Japan, Transactions of the Seismological Society of, 67,
Education in, 88; Japanese Playing Cards, Mrs. Van
Renuselter, 16a; Melecotology in, 207, Journal of the
College of Science, Imperial University, 208, Pines and Fris
of Japan, Dr. Maxwell T. Masiers, F. R.S., 339; Agriculture
in Japan, Manuring Faperments with Paddy, Dr. O. Kal-

ner, V. Kozai, V. Mori, and M. Nagaoka, 353; Acclimatiza-tion of Japanese Lacquer tree at Frankfort, Prof. Rein, 500 Japp (F. R. J. R. S.), the Gravivolumeter, 72 Jaw in Civilized Races, the Dimination of the, F. H. Collins, 326

320 | Luminous Clouds, 229 | Johns Hopkins University, Manne Laboratory of, 206 | Johnson (C S.), Organie Bases in the Juice of Flesh, 117 | Johnson (T T), a New Yorm of Student's Microscope, 239

Johnson's Visitor's Companion to Eastbourne, 388 obnston (H H), Lyingstone and the Exploration of Central

Johnston (H. I.), Tanganan Official Record, 1891, 196 Johnston-Laws (Dr. H. J.) the Fraption of Venuras, Jane 7, 1891, 166, 320, the State of Venurus, 271, South Italian Myu of Monte Somma and Venurus, 271, South Italian

Nap of Monte Somma and Veduvins, 271, South Italian Volunnes, 373, a Concise Manual of Botany for Students of Molicine and Seenee, 57 Joly v. V. Research on Separation of Acids from Platinum, 144, 18ce verbees on Commun, Contamire Acid, and Osmi

amates, 216

anistee, 210
[oly 1], the Meldometer, 187
[olec (Prof. D. F.), on Electric Waves in Wires, 454
[oneto if (Barona), Trait prasqued of Chimie Melalurgique, Prof.
W. C., Kolsetts Austen, F. R. 7, 245
[orisen (F.), Luniumarine, a New Glincoside from Limina

usilalistimum, 312

ustidistonum, 312
Journal of Anatomy and Physiology, 576
Journal of the Anthropological Institute, 114
Journal of Boxin, 236, 335, 559
Journal of the College of Science, Imperial University, Japan, 208

200
Journal for Ornthologie, 324
Journal of the Royal Horicultural Society, 477
Journal of the Russan Chemical and Physical Society, 458
Judd (Hof John W. R S) the Registencence of Crystab, 83, Crysallography for Suedients of Chemistry, Physics, and Mineralogy, occoge Huntington William, 193
Junelle (HJ.) Disengagement of Oxygen by Plants at Low

Juneile (11), Disengagement of Oxygen by Plants at Low Temperatures, 216 Jungle Cock the Crowing of the, 30, Jackals and the, S. E. Peal, 30, 31, the Crowing of the, Il. P. Cross, 151 Jupiter, the Action of, on Couries, Prof. Newton, 453 Jupiter and his Markings, W. F. Denning, 439 Jupiter's First Satellite, 631 Just (Dr. L.), Death of, 450

Just Intonation, Instruments in, 146; Robt A Lelifeldt, 119

kaffraria, Hand book of the Ferns of, F R Sim, J. G Baker, F R S , 75 Kaninia, a New Species of Truffle, A. Chatin, 512

Namine, a New Species of Francis A. Chairin, 512
Kangaroo, New Species of, 422
Kazake Glaceres, Sonswips of the, D. Woenkof, 600
Keegan (Dr. P. Q), a Lanar Rambow, 591
Keegan (Dr. P. Q), a Lanar Rambow, 591
Keegan (Dr. P. Q), Manuing Experiments with Paddy in

Kelliner (Dr. O.), Manusing Experiments with Fastily in Aplana, 33, mon Goographed Education, 500 Kelweyk (Mr. C. E.) Apparatus for Maruse and General Electrical Signalling, 575 Kew Holletin, 110, 323 Kew Holletin, 110, 325 Kew H Kilimanjaro, an Account of the First Ascent of, Dr. Hans

Meyer, 149 Kimball (J P), Genesas of Iron Ores by Isomorphous and

Rimball (J. P.), Genesia of Iron Ores by Isomorphous and Preudomonphous Replacement of Limestone, 453 Kindergarten System in New York, 502 King (Dr. George, F. R.S.). Maternals for a Flora of the Malayan Pernasula, 492; Botanical Survey in Assam and

Beauty Community of the J. W. Hall, 502 Beauty St. M. Hall, 502 Kurk (T. W.), Sparrows and Hawk in New Zealand, 503 Kurk (T. W.), Sparrows and Hawk in New Zealand, 503 Kurk (T. W.), Sparrows and Hawk in New Zealand, 503 Kurky (Rev.) John II.), Refraction through a Prism, 294 Kutasato (197) and Dr. Hebring, Immunity, Natural and

Kitchen Range, Waste in the Use of the Ordinary, 354 Klein (Dr.), Immunity, Natural and Acquired, 422 Klenze (Herr), the Digestibility of Different Kinds of Cheese,

Xhenza (terri), use M₁-rosses, 2325 Knott (Prof C. G.): some Relations between Magnetism and Twist in Iron, Nickel, and Coball, 191; Electric Resistance of Cobalt at High Temperatures, 311, Thermo-electric Positions of Cobali and Basauth, 311 Koch's (Dr.) Present Views regarding Tuberculin, Prof Ehrlich,

398

398
Kenng (Dr. A.), Ornithological Observations in Madeira and the Canary Islands, 163
Kooppelin (Kodolphe), Death and Obituary Notice of, 231
Koh-l-Nur, a Criticism, Prof. N. Story-Mask-lyne, F. R. S., 555
Kora-War, a Reply. V Ball, F. R. S., 522
Kra-War, Clr.), the Slow Combustion of Explosive Gas Mixture-,

354 Krischiafovlich (N), Traces of an Inter-glacial Period in Middle

Russia, 232
Kruss (Dr) and Dr Ohnmais, on the Crystallization of

Ammonium Sulphovansdate, 19
Kukenthal (Willy), Porposes in African Rivers, 175
Kunz (G F.), Emission of Light by Diamondy in Darkness, 88

Laboratory, Marine, of Johns Hopkins University, 206 Laboratory Reports of the Royal College of Physicians of Edilibutgh, J. Gorge Adami, 73 Labrador, American Ethnological Expedition to, 185 Labrador, American Ethnological Expedition to, 185 Lachaud (M.), Researches on Thallium, 336

Lacquer Tree at Frankfort, Acclimatization of the Prof Rein. 500

Lake Water, Fluctuations in Height of, P. da Boys, 120
Lalands (F. de), New Models of Copper Oxide Batterne, 144
Lancaster (M.), Normal Temperature in Europe, 437
Lang (Dr. C.), Secular Variations of Damage by Lightning and
Langdon (William), Railway Tran. Lighting, 44
Langdon (William), Railway Tran. Lighting, 44
Langdong, the Formation of, W. J. Stillman, 165
Langley (For S. P.), Experimental Researches on Mechanical
Flight, 277
Lantester (From E. Rey, F.R. S.) the University of London,
Lantester (From E. Rey, F.R. S.) the University of London,
F.R.S., and Richard Lydekker, 121, the Proposed Albert
Linversity, 222, Lessoon in Elementary Biology, For T.
University, 222, Lessoon in Elementary Biology, For T.

F.R.S., and Kichard Lydekker, 121, the Proposed Albert University, 222, Lestons in Elementary Biology, Prof T. Jeffery Parker, F. R. S., 390, Die Organisation der Inrhellaria Accela, Dr. Ludwig von Graff, 465
Lanthanum, Dr. Brauner on, 68
Treatment of, Lord Rayleigh, F.R.S., 499, 597, Prof. P. G., Treatment of, Lord Rayleigh, F.R.S., 499, 597, Prof. P. G.

Treatment of, Lord Rayleigh, F. R. S., 499, 597, Prof. P. G. Tatt, 546, 627 Mg, 493, 614
Larmor (Alex), Geometry of Poutton, by R. H. Graham, 195
Larmor (J), the Theory of Electrodynamics, 139
Law of Tenson, H. G. Williams, 591
Lawernee (G. F.), Drift Implement of Unusual Form found in Oxford Street, 282

Oxford Street, 282
Laws of Force and Motton, John Harrs, 443
Lawson (Inspector-General), on the Communicability of Cholera from one Country to another, 266
Le Conte (Prof John), Death of, 17
Locale (Prof John), Death of, 17
Locale (Prof John), Parposes of the International GeoLocale (Prof John), Parposes of the International GeoLocale (Marchael Locale), Locale (Locale Locale), Lea (M. Carry), Blue Silver, 189, Allotropic Silver, 584
Leak (M. Carry), Blue Silver, 189, Allotropic Silver, 584
Leaknater (G.), Varantion of Composition of Jerushaelm Artichokes at Different Persols of Growth, 608
Leethinas, Bloogoal Functions of the, Walter Maxwell, 471
Ledite (J.A.): New Gravimenro Method of averraining Capital
Ledite (J.A.): Alwords of Marchaelm (Locale Locale Locale

Oxygen, Hydrogen, and Nitrogen, 316, the Expansion of Phenyheria, Sirk C. A Barter appointed Superintendent of the Agricultural Department of, 459
Liffmann (Dr. Henry) and William Beam, Examination of Wilder for Saniary and Technical Furposer, 102
William (Dr. Henry) and William Beam, Examination of Wilder for Saniary and Technical Furposer, 103
Liffmann (Dr. O.) on Micro-Chemical Analysis, 519
Liffmann (Dr. O.) on Micro-Chemical Analysis, 79
Liffmann (Dr. O.) on Micro-Chem

Leidy (Prof. Joseph, M.D.) Death of, 17; Obituary Notice of, 63, Proposed Memorial to, 351
Lenses, on the Measurement of, Prof S. P. Thompson, F. R. S... 455

455
Leon (Prof), a Two-legged Cat, 600
Lepidoptera, South African, Rearrangement by Mr R Trimen
of the South African Miseum Collection of, 207
Lepterre (C.), Researches on Thallum, 336
Leptropy Maculius cultivated in berum by Drs. Rake and Buck-

master and Surgeon Major Thomson, 161
Lep.osy, Indian Report on, 436
Leste, or Hot Wind of Madeira, Dr. H. Coupland Taylor, 95

Leste, or Hot Wind of Machin, J. Levander (F. C.), a Kare Phenomenon, 519 Levandt (brank). Pletstocene Fluvial Planes of Western

Pennsylvania, 463 ewes, Discovery of Anglo Saxon Skeletons near, 575 Lewes (Prof Vivian B), on the Spontaneous Ignition of Coal,

Ley (Rev W Clement), Frratic Track of a Barometric Depres-

ston, 150 Leyden Jars, Experiments with, Prof O Lodge, FRS. 218 Liberia, Projected Natural History Expedition by O. F. Cook to, 548

to, 548
Library Association, Annual Mening of, 277
Library Association, Annual Mening of, 277
Library Association, Annual Mening of, 277
Library Association, Annual Mening of Lord of, 600
Light Diffused by Shy, Analysis of, A. Crow, 144
Library Association of Mening of Pass of, Herr Huffert, 478
Short, Biological Resings of Fast of, Herr Huffert, 478
Library Association of Herrica of Mening of Library of Mening of Library of Mening of Library of Mening of Library of Mening of Charch at Needwood, Curous Case of Damige Dy, A. J. Hands, 239
Library Association of Mening of

A J Hands, 239 Lightning Conductors, Relative Merits of Different Kinds of Points, Dr. Hess, 559 Lightning, a Curious Case of Globular, 227 Lightning, Damage by, to State Buildings in Prussia, 1877–86,

Lightning Spectra, W. E. Wood, 504 Liquid Prisms, Prof. W. N. Hartley, P. R.S., 273 Liquids, the Measurement of the Compressibility of, S. Skinner

94 Lequids and Gaves, Prof. W. Ram vy, F. R. S., 274
Lequids, Instrument for Optical Comparison of Franspaces,
Section of Comparison of Franspaces,
Section of Comparison of Comparison of Common Surface of Two, III., C. Van der Mendhoughte, 240
Lequidocope, Instrument for Optical Comparison of Fransparent
Liquids, M. Nonden, 478
Liquids, M. Nonden, 478
Liquids, M. Sonden, 478
Liquids, M.

Linamarine, a New Glucoside from Linum unitalissimum, A

Linamarine, a New Glucoside from Innum utilalistimum, A Jonssen and E. Hairs, 312
Linear Arrangement of Siars, 478
Linnean Society, 95, 118, 166, 215, Gold Medal awarded to Dr Edouard Bornet, 111

Linnean Society of New South Wales, 233
Lister (J. S.), Abnormal Development of Arms and Chests of
Fakaofa Islanders presumably caused by Constant Paddling,

Litvinoff (D I), Geo-Boianical Notes on Flora of European

Russia, 359 Liveing (G. D., F.R. S.), Crystallization, 156

Liveing (G. D., F.R. S.), Crystallization, 156
Liverpool, Contemplated Geographical Society at, 161
Liverpool, the Geology of the Country around, G. H. Morton,
Frof. W. Boyd Dawkins, F.R.S., 172
Liverpool, Mr. Francis Gotch appointed Professor of Physiology
at University College, 257
Liverpool, and the Exploration of Central Africa, II. II.

Laving-tone and the Exploration of Central Africa, II II Johnstone, 492
Lizard District, Crystaline Rocks of the, Prof T G B.nney, F R S, and Gereral C. A McMahon, 22
Lockhart J G. the Estatus of the Moose, 42
Lockhart J G. the Estatus of the Moose, 42
Lockhart J G. the Estatus of the Moose, 43
Lockhart J G. the Solar Corons, 300
Lock Line of Astronomy, 8, 57, 107, 199, Physical Science for Artists, 175, 247, the Solar Corons, 300
Locustin Egypt, 40
Locket Fard. Other Corons, 300
Locket Fard. Other Corons, 300
Locket Fard. Other Corons, 43
Moose mat Richer, 238, Experiments with Leyelin Jur, 238, Opening Address in Section A of the British Association,

382, on whether the Ether lehaves as a Viscous Fluid, 454, on Light in Modifying the Effect of the Gravitational Attraction of the Sun, 454
London Entomological Society, 359
London Entomological Society, 359
London Geological Field Class, Hand-book of the, 317

London Mathematical Society, 598
London, University of Draft Charter of the, 39, Prof E. Ray
Lankester, F R S., 76, Prof William Ramsay, F R S., 78,
Dr A Irving, 79, 104, B.Sc Exam, 1892, Edward J

Burrell, 565 Longstaff (George Blundell), Studies in Stati-ties, 4 Lorenz (Dr. Richard) · Troilite, Meteoritic Crystallized Mono

Lorenze (Ar. Alensed): If the third the third and the subject of tron, 137, 11/genic Advantage of Erect as compared with Stanting Writing, 335 Lowne (B. Thompson), the filow by 13 Lowne (B. Thompson), the filow by 13 Lowne (B. Thompson), the filow by 13 Lowne (B. Ghward), Dealh and Obituary Notice of, 574

Lucias (Prof. Edward), Death and Contary Society Luminous Clouds, O Jesse, 229 Lunar Heat, Distribution of, Frank H Very, 601 Lunar Libratton, a Cause of, S E Peal, 283 Lunar Radiant Heat, Messurements of, 577

Lunar Rambow, Dr P Q Keegan, 591
Lupton (Sydney), the Conditions of Space, 210
Lydekker (Richard) the Fossil Insects of North America, with

Notes on some European Species, by Samuel H & Scudder, I, and Prof. W. Il Flower, F R S, Mammals Living and Fxtinct, Prof E Ray Lankester, F R S, 121, Lower Jaws of Procopiodon, 143, F Priem on the Fvolution of Annals.

Lyrm, Spectrum of S. Prof E. C. Pickering, 355

MeAlpine (D), Summary of Tasks undertaken by Departmenof Agriculture, Victoria, 529
Macdonald (Major Claud M.), on the Benue and the Kiblić, 46
M'Fadyean (Prof.), on the Milk and Meat of Tuberculous

M Falyean (1701), on the Milk and Meat of Tubercalous Animals, 200 J M) Comparison of Minute Structure of Plant Hybrids with Parent Plants, 119, Vegetable and Animal Cells, 263
Animal Cells, 263
Animal Cells, 263

McGowan (G.), Method for Estimation of Nitrates, 118

McGowan (G.), Method for Estimation of Nitrates, 118
McGurret (J.) Primituve Man and Vison Hammers, 509
McEstock (Prof.), on Marine Food-I-sibes, 360
McEstock (Prof.), on Marine Food-I-sibes, 360
McEstock (Prof.), on Marine Food-I-sibes, 360
McKendriet (Dr.) (John C.), R E. S. Jand W. Smodgress, Note on
McKendriet (Dr.) (Marine), McKendriet (Marinet), Marinet (Marinet), McKendriet (Marinet), M

McMahon (General C A) and Prof T G Bonney, F R S. on the Crystalline Rocks of the Lirard District, 22

on the Crystanian Rocks of the Liver District, 22 McPhe (Alexander), Exploration of Central Australia, 67 McPherson (Rev. J G), the Fairyland Tales of Science, 5 Madagascar, Scientific Expedition by M Douillot to, 111 Maders, the "Leste" or Hot Wind of, Dr II. Coupland

Taylor, 95 Madras Central Museum, 629 Madras Observatory, the late Mr Pogson's Observations at.

288

Magelssen (Herr), Weather and Disease, 113 Magnetism · Magnetic Declination or Variation of the Compass agnetisms - Magnetic Declination or variation of the Compass at Washington, Graphic Daily Record of, Richardson Clooer, 82. Magnetic Anomalies in Rusua, General A de Tillo, 33. Magnetic Anomalies, Alfonso Sella, 249. Magnetic Observations, Washington, 91; Effect of Heat upon the Magnetic Succeptibility of Nickel, S Bdwell, F.R.S, 187; some Relations between Magnetism and Twist in Iron, Nickel, and Cobalt, Prof. C. G. Knott, 191; Comparison of Simultaneous Magnetie Disturbances at various Observatories, Simultaneous Magnetic Disturbances at vanous Observatores, and Determination of the Value of Gaussian Coefficients for those Observatores, Prof. W. G. Adeus, P. R.S., 237, and Introduction to the Mathematican Theory of Electriciny and Magnetism, W. T. A. Emisage, 443; Prof. Frank H. Bigelow, on Ferrestral Magnetism and Kadaint Smilghi, 455, P. T. Trodico on the Propagation of Magnetization in Iron, 455, Period Conference on the Propagation of Magnetization in Iron, 455, Period Conference on the Propagation of Magnetization in Iron, 455, Period Conference on the Propagation of Magnetization in Iron, 455, Period Magnetization in Iron, 455, Ewing, F.R S., 566

Maiden (J. II), Wattle and Wattle Barks, 577
Makareff (Vice-Admiral), Measurement of Density of Sea-Water, 359

Water, 339
Malay Pennsula, the Aborigmes of the, 600
Malayan Pennsula, Materials for a Flora of the, George King,
F R S, 492
Mallock (A, Photographic Definition, 552
Mallock (A), Photographic Definition, 552
Mallock, Landi, Geology of, J II Cooke, 550
Malmal, a New, from Sumarta, Prof A A W. Hubrecht,
Mammal, a New, from Sumarta, Prof A A W. Hubrecht,

Mammals in Calcutta Museum, Completion of Catalogue of,

Mammals Living and Extinct, by Prof W. H. Flower, F.R.S., and Richard Lydekker, Prof. E Ray Lankester, F.R.S.,

Man (E. II), on Nicobar Pottery, 512 Manchester Technical School, New Physics and Electrical Fingmeering Department at, 475
Mangrove in the Royal Botanic Gardens, the White, 304
Mangrove, Acrial Roots of the, Alfred W. Bennett, 370

Manson (Dr.), on Filaria ianguini, 367
Manson (Marsden), Physical and Geological Traces of Cyclone

Belts, 389
Map, Geological, of Monte Somma and Vesavius, H. J.

Map, Gological, or notine declarated plots that the Johnston Livins, 271
Map Colouring and Cartography, Major J. W. Powell, 506
Marble Quarrying in the United State, E. R. Morse, 579
Marchand (M.), Observations of San-spots and Facula, 236
Marchand (M.), Observations of San-spots and Facula, 236

Marcograph in Pola and Trieste Harbours, the Lieutenant Gratzl, 600

Marey (M), Insect flight studied by Photochronography, 264 Marine Biological Association of the United Kingdom, 205, Marine Biology, a Pink Marine Micro-organism, Prof W. A

Herdman, 505 Marine, Colour Fests used in Examinations for Mcreantile, G. J Swanston, 500

Marine Laboratory of the Johns Hopkins University, 200 Marine Micro-organism, Pink, Prof W A Ulcrdman, 565 Marine Survey of India, the Cruise of the Investigator, Dr.

A Alcock, 501 A Alcock, 501
Marine Survey of India, Captain R F Hoskyn, 528, the
Cruise of the Investigator, Dr. A Alcock's Report, 528
Marrice's Compass, sit at Chinese, Investion's, 308
Marri Globa Pedward), Proposed Fellow of the Royal Society, 16
Marriage, the History of Human, Prof W Robertson Smith,
Edward Westermarck, 270
Mach (J. E.), Prof f "H Van't Hoff's Chematry in Space,

Marshall (Arthur), a Rare Phenomenon, 519

Marshall (Dr.), on Persulphates, 577
Marshall (Mrss), Bequest to the Science and Art Depart-

ment, 17 Marshall Scholarship, the Huyley Laboratory for Biological Research, and the 627 Marshall (W), the Addition of Alcohol Elements to Ethereal Salts of Unsturated Acids, 118

Salts of Unsaturated Actors, 113
Marsupial, Notoryette typhiops, the New Australian, 135, 188,
Dr. P. L. Sclater, F. R. S., 449
Martin (Horace C.), Notes on Elementary Physiography, 589
Martin (Prof. Tuo), the Crystallization of Thin Liquid Films,

Martinique, Terrible Cyclone at, 416, 575
Maryland, South, Scientific Expedition for Investigation of

208

Maskell (W. II.), on the Coccide, 550
Maspero (M.), the Dog in Ancient Egypt, 207
Massachusetts, Old Time Winters in Essex County, Mr. Perley,

353
Masters (Dr. Maxwell T , F.R S) Pines and Firs of Japan,

339
Maternity Hospitals on the Improved Hygienic Condition of,
Dr W O Friestley, 485
Mathematics . Rider Papers on Euclid, Books I.-II., Rupert ancianus. Nover expers on Localio, Boost J.-H., Rupert Deakun, 76, Quatermons and the Ausdehaungslehe, Prof. J. Willard Gibbs, 79, Mathematical Society, 96, 191, Dif-ferential and integral Calculus with Applications, Pof. A. G. Greenhill, F.R. S., 170, Pascal's Hexagram, H. W. Rehmond, 181 Geometry of Position, K. H. Graham

Alea. Larmor, 195, the Conditions of Space, Sydney Lupton, 210; Graphical States, by 1 upt Cremons, transilisation of La Prof. Thomas Hudson Beare, 22; a Demonstration of La Prof. Thomas Hudson Beare, 22; a Demonstration of La Equations, Prof. Chymal, 310, on some Test Cases for the Maxwell-Holtmann Doctine regenting Dustrabition of Energy, Ser William Thomson, F.R.S., 355, the Laws of Forces and Moton, John Earms, 443, an Introducent Cases for the AL Emisge, 443, Evolution of Algebra, Prof. E. W. Hyde, 70, W. = Mg, V. Larden, 493, Tommy Aldran, Sen., 491. Lord Rayleigh, F.R.S., on Van der Waale's Treatment of Luptice's Pressure in the Viral Equation, 493, 937, Prof. Eugens. P. G. Tait, 546, 627

Mather (T.), Construction of Non inductive Resistances, 261

Matignon (W. C.), Parabanic and Oxaluric Acids, 336, Heat

Combustion and Formation of Natro-henzenes, 360 Mauritius, Report of the Royal Alfred Observatory, 66,

Meteorology of, 451
Maury's (M. Paul) Botanical Expedition to Mexico, 598

anaurys (M. 17au) Botanical Expedition to Mexico, 598
Maxim's New Hying Machine, 303
Maxwell-Holtzmann Doctrine Regarding Distribution of
Energy, on some Test Cases for the, Sir William Thomson,
P.R.S. 328

P.R.S., 355
Maxwell (bir Herbert), Rock-sculptures in Scotland, 350
Maxwell (Walter), Biological Functions of the Lectiones.

Maxwell's Electro-magnetic Theories, Prof A Gray, 296

Measurement of Lunar Radiant Heat, 577
Mechanical Engineers, Institution of, 20, 332

Mechanical Flight, Experimental Researches on, Prof S P

Mechanical Plight, Experimental Reservines on, 100 of Jafagley, 27 Mechanic Influence of Surface and noing on Hierarch et Heart, Mechanic Influence of Surface and Committee on Surface and Surface an 510

Medical Library, Catalogue of the Washington, Dr A T Myers, 563 Medical Society, 548

Medicine, Account of the Birmingham School of, 18 Medicine, British Institute of Preventive, 86, 97, 111, 124, 135,

Medicine, Paris Academy of, Sir Joseph Fayrer and Dr Bate-

man elected Associates, 351
Medicine, the Progress of, Dr. T. Lauder Brinton, F.R.S., 327 Mediterranean, the Frigate Scilla fitting out by Italian Govern-

ment for Hydrographic Exploration of, 501
Mediterranean during July, Remarkable Atmospheric Effects in the, 502

the, 502
Mechan (T.), Relation between Invects and Forms and Characters of Flowers, 335
Meck (Alex.). Directing Products, 544, on Actinotinelia, 416
Melaneauns, the, Studies in their Anthropology and Folk-Lore,
Dr. R. H. Codrington, 613
Meldola (Prof. R., F.R.S.). Co adaptation, 7, 28, the Azo

Meldola (Prof. R. F. R. S.) Co adaptation, 7, 28, the Azo detivatives of B Aphthylamme, 18; Photography in Colours, Alphonse Berget, 194; Charles Darwin, his Life and Work, Charles Frederick Holder, 397; Scence or Romance, Rev John Gerard, S. J., 441; Technical Chemistry, 602 (Meldometer, the. J. 194), 18; Mendleteff (Prof.), on the Variation of the Density of Water at

Mehdeleen (Flot), on the variation of the Denny of Water at Different Temperatures, 334 Mensbrugghe (G Van der), Characteristic Property of Common Surfaces of Two Liquids under Mutual Affinity, III, 240 Menschutkin (N.), the Rate of Formation of Compound Ethers,

312 Mercadier (E), Determination of Constants and Coefficients of Mercadier (E. J. Determination of Constants and Cons

Meridian, Arguments against Adoption of Greenwich as Prime, M. Tondini. 119

Merle (William), Weather Record of the Fourteenth Century.

Merrill, (F I H), Post Glacial History of Hudson River

lerrili, (F. J. H.), Post Giacial History of Hudson River Valley, 189 feallurgy Leçons sur les Métaux, Prof. A. Ditte, 245. Traule pratique de Chimie Métallurgique, Baron Jonstoff, 245. Determination of Constants and Coefficients of Nickel Steel, Metallurgy Determination of Constants and Coefficients of Nickel Streft,

Mercader, 264, Rolling of Stref Sheets direct from
Molten Metal, Sir H. Beuener, 578; Examination of a Peculiar Form of Metallic Iron Ironiu on Lake Hiron, G. C.
3390, Cause of Insolubity of Pure Metals in Acids, Dr.
Wetern, 259

Metchnidof, Immunity Natural and Acquired, 422

Metchnidof, Immunity Natural and Acquired, 422

Metchnidof, Industry Natural Acquired, Acquired, 422

Metchnidof, Industry Natural Acquired, 422

Metchnidof, Industry Natural Acquired, 422

Metchnidof, Industry Natural Acquired, 423

Metchnidof, Industry Natural Acquired, 423

Metchnidof, Acquired, 424

Metchnidof, Acquired, 424

Metchnidof, Acquired, 424

Metchnidof, 424

Il Seemann on European Weather Charts, 41, Daily International Weather Charts, 62, Prof Hellmann on Baronetric Observations, 66, Self recording Instruments, 66, Report of the Royal Alfred Observations, Mauritus, 66, Dry and Moist T-mperature and Health, 66, the Influence of Forests on Air-Temperature, 68, Unaplie Daily Record of the Magnetic Declination or Variation of the Compass at of the Magnetic Declination or Variation of the Compass at Washington, U S A, 82, Magnetic Anomalies in Russia, General A de Tillo, 83, Weather Service of the United States, 88, Meteorological Service of Australasia, 85, Washington Magnetic Observations, 1886, 91, American Meteorological Journal, 92, 440, 464, Funstion of Viorte, Meteorological journal, 92, 440, 464, Framation of Storms, W H Dines, 95, Ilrocken species in a London Fog, A W Clayden, 95, an Account of the "Leste" or Ilot Wind of Madeira, Dr. Il Coupland Taylor, 95, the Fifet of an Electric Dischauge upon the Condensation of Steam, Shelford Millot, 112, Studies of Air Pressure and Temperature on de Bort, 112, Studies of Air Pressure and Temperature on Summit of Sonnhileck, Dr. J. Hann, 112, Weather and Disease, Heir Magelssen, 113, 5 now Observations in Russa, Herr Berg, 113, Observations of Hali in Process of Forma-tion, 1706, Tosentl, 113, a Method of Counting Water-Particles in Fog, John Aitken, 119, Analysis of Sanlight Diffused by the Sky, A Crova, 119, Aumospheric Condition Exmused by the Sky, A Crova, 119, Almospheric Conditi in of Greenwich with regard to Universal Hour Question, M Tondini, 119, Canadian Meteorological Service, Report for 1887 of, 136, Determination of I vaporating Power of a Climate, Dr Ule, 137, Analysis of Light Diffused by the Sky, A Crova, 144. Erratic Irack of a Barometric Depression, Rev. W. Crova, 144, s. traite I rack of a liaronisertic I repression, see. v. Clement Ley, 150, New Russian Meteorological Keview, 161, 326. Cold Waves, 170f I Russell, 165, How can Weather Service best promote Agriculture?, M. Willarmigton, 165, la Influenza spread by Wind?, H. II. Hildebrandson, 165, la Influenza and Ben News Observatory in Kultuton to Wind, Promoteer at Ben News Observatory in Kurtion to Wind, Dr Bueham, 167, Currents that give ruse to Cyclones, Il Faye, 168, Meteorology to Plars, 185, the Winds of Ben News, R. T. Omond and A. Rankin, 191, the Heavy November Rank and Floods in Germany, Frof. Hellmann, 190, when and Floods in Germany, Frof. Hellmann, November Kains and Floods in Germany. Frol Helimann, 206, Meteorology in Japan, 207, Frintie Barometric Die prevsion of May 23 39, and Hailstorn of May 24, B J Hopkins, 224, on a Cycle in Washer Chaege, 225; Life Forcast of the Indiah Monsoon Rains, 225 Luminous Clouds, O. Jesse, 229, Luminous Clouds, 31, Study of Remarkable Series of Hailstones at Gras, Prof Probasek. 233; Meteorological Service established in Alsace Lorraine, 233; Curious Case of Damage by Lightning to Church at Needwood, A. J. Hands, 239, Comparison of Thermometri. cal Observations in Stevenson Screen with same on Revolving cal Observations in Stevenson Screen with same on Revelving Stand at Greenwish Observatory, W. Bills, 391, Contin-Stand at Greenwish Observatory, W. Bills, 391, Contin-Stand Continued and Continued Standard Sta

Meteorological Observations at Sydney for January 1891, 304, Zoducal Light as related to Aurora, O T Sherman, 310-10, the Climate of Cephalonia, D. Partich, 336. Meteorological Cephalonia, D. Partich, 336. Meteorological Journal, New Russian Meteorological Journal, 848, 20. Mostyn, 324; Secular Variations of Damage by Lightining and Hail, Dr. C. Lang, 354, Rain Gauges, Nay. C. Mostyn, 324; Secular Variations of Damage by Lightining and Hail, Dr. C. Lang, 354, Rain Gauges, Thomas Pietcher, 371; Congraphy of the Art., Lentennal A. Territonia, Pietcher, 371; Congraphy of the Art., Lentennal Cyclone Belts, Marsden Manson, 389; Meteorology of the Estern Seas, Dr. Doberck, 389, Annales of the Central Meteorological Office of Paris, 389; Meteorology of the Charles of Congraphy, 389; Claud Heights, Kinematte Method, Prof Cleveland Abbs, 398, Terrible Cyclone at Martinine, 446, 575. Action makings Arthurents, 461 and Partinional Conference at Munich, 435, the Present Methods of reducing Meteorology and Measurements, Prof. II Mohn, 446; Frof. W von Normal Temperature in Europe, 437; II Morrec on the Chmistology of Mauritius, 451, of Cape Colony, 451, Monatian Condens, 452, and 454, Climatic History of Lick Bonneville, R. de C. Ward, 464, Climatic Olymbia, 1800, 2016. Routes for Steamships between Aden and the Straits of Sunda, 476, Symons's British Rainfall, 1890, 477, Extraordinary Rainfall (1890) in Australia, Charles Todd, 501, Damage by Lightning to State Buildings in Prussia, 1877-86, 501, Kanfall (1890) in Australin, Charles Todd, 501, Danaige by Lighting to State Individues in Provas, 879–86, 901. Sept. 1997–86, 901. Sept. 1997. Sept.

335
Mesico, American Expeditions to investigate the Flora of, 501
Mesico, M. Paul Maury's Expedition 10, 598
Meyer (Prof. Frinst von), a History of Chemistry from the
Earliest Times to the Present Day, Prof. T. E. Thorpe, F. R. S.,

Meyer (Dr. Hans), an Account of the First Ascent of Kılıma-

mary 149
Meyer (Dr. Hugo), Anleitung zur Bearbeitung meteorologischer
Beobachtungen für die Klimatologie, 27
Meyer (Prof Victor), the Slow Combustion of Explosive Gas

Mixtures, 354
Miall (Prof. L C), some Difficulties in the Life of Aquatic

man (Froi. L. C.), some Difficulties in the Lafe of Aquatic Insects, 457 Mica as an Invariable Dielectric, 23 Mica, Dielectric Properties of, at High Temperatures, E. Bouty, 168

168
Micacous Trachyte, Artificial Production of, 392
Micro chemical Analysis, Dr. O. Lehmann con, 76
Micro chemical Analysis, Dr. O. Lehmann con, 76
Micro chemical Carlos, 197
Microcloft, Dr. L. Trouessart, 197
Microcloften, s. New Antiseptic, Prof. Berlioz, 323
Microcloften, s. New Antiseptic, Prof. Berlioz, 323
Microcloften, 197
Mic

fell, 142, Tenna Iamoolate in Duck, J. B. Rosslier, 143; New Projection Microscope, E. M. Nelson, 143; i. Negative of Amfajefane pollusafa produced with Zeisk New & of 16 N A and Sanlapt, by T. Comber, 239; Nelson States of 16 N A and Sanlapt, by T. Comber, 239; Nelson States of the States of t

Heat, 168
Mik and Meat of Tuberculous Animals, the Alleged Danger of Consuming, Dr Bing, 393; Frof. Arboing, 396, Prof. MFadyean, 395; Frof Hamilton, 397, Prof Nocard, 397, Dr Iline, 397, Dr Batlow, 397, Prof. Permontol, 397
Mil(Dr H R), Physical Geography of Clyde Sea Area,

Millson (Alvan), the Yoruba Country, 209

Minicry in Spiders, F. Heckel, 451

Minicry in Spiders, F. Heckel, 451

Mind. Retirement of Prof. Croom Robertson from the Editorship of, 548

Mineralogy Prof T G Bonney, F R S, and General C. A McMahon on the Crystalline Rocks of the Lizard District. 22: McMahon on the Crystalline Rocks of the Lizard District, 23; an Introduction to the Study of Petrology, by Dr. Frederick II. Hatch, 25. Dr. Brauner on Lanthanum, 68, the Rejuvence-cene of Crystals, Prof John W. Judd, F. R. S, 83; a New Sitter Minetal, 89, Crystals of Platnum, J. Joly, 124, 17., crucus Opril in New Sunth Wales, 162; Elements of 124, 17, co-us, Opd in New South Wales, 162, Elements of Crystallography, George Huntingdon Williams, Tord John W Judak, F. S., 193, Mineralogical Society, 215, 574, the tile and Ta-belfikanie, L. E. Eskins, 310, the Minerals in Hollow Rhyolite Spherules, J. P. Iddings and S. L. Penfield, 310, Bernar-Intie, 1 in a Mineral or a Fugury, 17, S. Hown, 310, Conclusive From Nova Socia, L. V. Prisson, 310, Analyses of Kanaster, Tentis, and Plessotte from Welland Analyses of hamacite, Jamite, and Plessite from Welland Meteone Iron, J. M. Davidon, 310, Newtonite and Rectourie, New Minerals of the kandinute Group, R. N. Brackett and J. F. Williams, 320, Iron in Gold washings about Berezowski, 336, Geness of Iron Ores by Josoporphus and Pesudomorphosa Replacement of Limestone, P. F. Kimball, 463, Allgement chemische Mineralogie, Dr. C. Dodlert, 310, Capture of a Supposed cuer Their al Vienna, 598 Mines and Mining Bepartment of Chicago Exhibition, 476 Mines and Mining Department of Chicago Exhibition, 476 Mines and Sono and Mining Department of Chicago Exhibition, 476 Mines and Mining Department of Chicago Exhibition, 476 Mines and Mining Department of Chicago Exhibition, 476 Mines and Mining Mines and Mini

Silicon, 120

Shiron, 120
Mining Engineer, Federated Institution of, 65, 800
Mining Engineer, Federated Institution of, 65, 800
Mining Engineer, Federated Institution of, 68, 800
Mining Engineer, Federated Institution of, 68, 800
Mining Engineer, 1997
Mini

Measurements, 436

Measurements, 430
Moi-san (Henri) Action of Fluorine upon Phosphorus Tri
fluoride, 186, 333, 622, Study of Tetra todide of Carbon, 26c
Mole, the Australian Marsupual, Notoryctes typhlops, Dr. P. L. Sclater, F R S, 449

Molecular Process in Magnetic Induction, Prof J A. Ewing,

FRS, 566
Molecular Weights at Critical Point, Determination of, P. A

Guye, 144 Monaco's (Prince of) New Yacht for the Study of the Sea, 359

Monaco' (l'fince oi) New Yadit Ior Ithe Sindy oi tine nea, 359 Monacreff (Sir Colin), on Egyptian Irrigation, 142, 151 Mond (Ladwig) Proposed Fellow of the Royal Society, 165, Nickel Carbon Oxide, 188, a Volatite Compound of Iron and Carbonic Oxide, 234, Iron-Carbonyl, 304 Monkeya, Results of Hemistection of Spinal Cord in, F. W.

Mott, 189 Monsoon Rains, I'o ecasts of the Indian, 225

Mont Blanc, Projecte i Observatory on, 302, 416
Monte Somma and Vesuvius, Geological Map of, II. J.

Johnston-Lavis, 271 Monuments in Egypt, the Preservation of Ancient, 28r Monuments in France, the Protection of Prehistoric, 2:

Monuments in France, the Protection of Prehistoric, 232

Moon, Bright Streaks on the Astronomer-Royal for Scotland.

360
Moon, Dr. Copeland on Bright Streaks in the, 454
Moor (C. G.), Disposal of Sewage, 456
Moore (Spence), the True Nature of Callus, 216
Moorland Parak, Forty Years in a, Rev. J. C. Atkinson, 122
Moose, the Habits of the, J. G. Lockhart, 114
Mogan (Prof. C. Lloyd): Force and Determinism, 249, 319

Morgan (T. 11.), Pycnogonids, 49 Morize (H.), on the Chmatology of Brazil, 437 Morley Memorial College, Muss Emma Cons. 469 Morphological Nature of Principle of Fecundation, Leon

Morphological Nature of Principle of Pectungation, Leon Guignard, 168 Morris (D.), Bolanical Expedition to the West Indies, 87, 110 Morse (E. R.), Marble Quarrying in United States, 576 Morton (G. H.), Geology of the Country around Liverpool, Prof. W. Boyd Dawkins, F.R.S., 172 Morton (Mr.), Discovery of Stalactife Caves in Taxemania, 576 Morquitores: the Destruction of, 591; W. Mattieu Williams,

519, Dragon flies 7, 491
Mostyn (C.), the Green Ray, 352
Mott (F. W.), Results of Hemisection of Spinal Cord in Monkeys, 189
Mouchez (Admiral), Annual Report of the Paris Observatory.

Mountain Chant, Miss Buckland on the, 511 Mountain Climbing in Greece, Dr Philipson, 599

Mountain Meteorology, A. L. Rotch, 464, 512

Mouse and Rat, the Development of the Dr. Arthur Robinson.

Muller (Prof. F. Max). Physical Religion, 219, Address on Anthropology at the British Association, 428 Mueller (Dr), Antagonistic Action of Strychnine and Snake Poison, 162

Mueller (Baron von), Green Eucalyptus Branches as a Disin

Meeller (Haron von), Green Buadyptus Branches as a Doin Gectant, 335.
Marphy (Joseph John) High and Low Level Meteorological Observations, 7. Electric, Transmission of Power, 590.
Misceller, Stimulating, by means of 1 july, 48. D'Ausonval, 390.
Misceller, Stimulating, by means of 1 july, 48. D'Ausonval, 390.
Misceller, Stimulating, by means of 1 july, 48. D'Ausonval, 390.
Misceller, Stimulating, by means of 1 july, 48. D'Ausonval, 390.
Misceller, Stimulating, 190.
Misceller, 190.
Misceller Musical Notes from Non Musical Sands, Cecil Carus Wilson,

322 Musquito Coast, Vocabularies from the, Dr D G Brinton, 600

Mycology, Royal Morphological Research Prize of 10,000 france awarded by the Accademia dei Lincei of Rome to Prof Saccardo, 257 yers (Dr A T), Catalogue of the Washington Medical Myers (Dr A

Library, 563
Myles (Rev. Perey W.), Death and Obituary Notice of, 598
Mylius (Dr.), Volatile Carbonyl Compounds of Platinum, 530

Nageli (Prof. Cail Wilhelm von) Death of, 65, Oberuary Notice of, D II Scott, 880 National Home Reading Union, Dr. Alex Hill, 493 Natural History New Stations in France, 135, Natural History in Public Schools, Rev T. A. Freston, 137, Con-templated Reorganization of the Frans Museum of Natural Hattory in Panel C Schools, Rev. 7 A., Freston, 137, Lond-Hattory, 184, 285, Mr. Ridercord I Duscetons on the Like-trance Hail of the Natural History Museum to illustrate variations in Deep Plantar Tendron of the Bard's Foot, 393, Museum, 451, a. New Mammal from Sumatra, Frod. A. A. W. Hubrech, 468, a Dog Story, John Bell, 321, Mr. O F. Cook's Projected Natural History Expedition to Laberta, Museum, 451, a. New Mammal from Sumatra, Frod. A. A. W. Hubrech, 468, a Dog Story, John Bell, 321, Mr. O F. Cook's Projected Natural History Expedition to Laberta, On From Market, 1981, and 1981, and 1981, and 1981, and 1981, and F. Cook's Projected Natural History Expedition to Laberta, Natural Science at Expedit Hollowy College, Appaintment of Natural Science at Expedit Hollowy College, Appaintment of Natural Science at Expedit Hollowy College, Appaintment of Natural Science at Expedit Hollowy, 1981, and 1981, a

Haddon, 188

New Mexico, Mr. C. L. Walker's Archieological Researches in

New Mexico, mr. c. L. Visiker S. Grebsongers Assessment South West, 576
New South Wakes Sydney Biological Station, 39, Precious Opal in, 162. Butter Export from, to England, 303;
Dairy Work in, 436, Royal Society of, 440, Department

of Agriculture in, 451

New York, Kundergerfen System in, 502

New Zealand; Journal of Science, Revival of, 18, Rees in,
C. M. Thomson, 19, Sparrows and Hawk in, J. W. kirk,
goy, the Basking Shark in New Zealand Waters, T. F.
Chesceman, 576

Chesceman, 577

Ches New York, Kindergarten System in, 502

Mollusca 1 i file British Museum (Natural History), 510
Newtonite, a New Mineral of the Kaolinite Group, R N
Brackett and 1 F Williams, 310
Nagara, Falls of, Proposal to Unitre the Power wasted in the,
517 W Steiners, 521
Nix, Jaland of, Uthorological Collection from, 68

Nicaragua, the Amerique Indiansof, J. Crawford, 502 Nichol-on Institute, Leck, 549 Nickel, Compounds of Destrose with the Oxides of A. C.

Chapman, 71
Nickel, I ffect of Heat upon Magnetic Sensibility of, S
Bidwell, F R S, 187

Bidwell, F R S, 187

336 Notes to the Physiological Action of Carbon Monovide of, Dr. John G. McKendrick, P. R. S., and W. Sindgrass, 70 Nickel Carbon Osuita, L. Mond, P. R. S., 188 Nickel Carbon Osuita, E. Mond, P. R. S., 188

455 Nickel Steel, Determination of Constants and Coefficients of,

E. Mercadier, 264 Nicobar Pottery, 1 11 Man on, 512 Nipiter (Prof. F. F.), on the Functions and Nature of the 1 ther

of Space, 471 Nitrates, Reduction of, by Sunlight, 24

Nitribeation, R Warington, 190
Nitribeation, R Warington, 190
Nitribeation, R Warington, 190
Nitribeation, R Warington, 190
Nitribeation, R Warington, 190 Berthelot and Matienon, 360

Nocard (Prof.), Iulierculosis, 397 Noelting (Dr.), New Method of Preparing Azoimide, 600

Nordenskold's (Baron), Antarctic Lxpedition, 231
Norfolk Geologist, the Life and Work of a, 612
Norfolk Geologist, the Jife and Work of a, 612
North America, Forestry in, Prof W. R. Fisher, 60
North America, the Ice Age in, G. Fredk Wright, Prof T. G.

North America, the Ice Age in, o Freux Vivigos, von 10 Banney, F. R. S., 537
Notes on Birds and Insects, J. Walker, F. R. S., 565
Notesynte typholys, the New Australian Marsupal Mole, 135, 188, Dr. P. L. Selater, F. R. S., 449, Prof. Alf.
N. Novton, F. R. S., 493
Nudibranchiate Mollusca, Herdman and Chubb on, 483
Fighter 144

Nudibranchiates, Development of I iver of, H. Fischer, 144
Numerals, Colour-Associations with, Dr. L. lward S. Holden,

Nunivak Islanders, the, Ivan l'etroff, 477

Nuovo Cimento, 136 Nuovo Giornale Botanico Italiano, 21, 236, 359

Observatories

Astronomers Work in a Modern Observatory, Dr. David Gill, P.R.S., Sociated Jaccal, High and Low Level - Joseph Joshn Murphy, 7; Barometer at Ben Nevis in Relation to Wind, Dr. A. Buchan, 167 Ogden (William B.), Bequest to the University of Chicago, 388 Olas, the Glacian Epoch Relica at Kelley Island, 207

Old Standards of Weights and Measures, 280 Olenellus Zone, the Discovery of, in the North West Highlands of Scotland, Sir Archibald Gelkee, F. RS 5, 479 Olive Growing in Australia, Principal Thomson, 501 Omond (R. T.), the Winds of Ben News, 191 Ontario, Wolves in, 18

Opal in New South Wales, Precoust, 162

Opinics - Dr Schobben's Lanten Sterooscope, 142; Apparatus
to show Greater Sensitiveness of Kye to Different Colours,
Captian Abney, F. R.S., and General Festing, F. R.S., 187,
An Optical Illusion, Prof. S. P. Thompson, F. R.S., 187,
Kefraction through a Prime, Rev. John II Kirkhy, 294,
Oscillations of the Reins, A Charpenner, 311, Instrument for the Optical Comparation of Transparent Liquids, Mi Sondén, 478, on Blending of Separate Chromatic Sensations perceived by each of Two Eyes, A. Chauveau, 488, Colour Sensations excited in One Eye by Coloured Light illuminating

Return of other, A. Chanvean, 536
Orange Disease in Cyprus, A. E. Shipley, 528
Oranges, Grapes, &c., the Cultivation of, in Greece and

Australia, 630

Admiralia, 230
Gregon, Discovery of Enormous Stalactite Cavern in, 23
Gregon, Discovery of Enormous Stalactite Cavern in, 23
Grelly (170 f. P.). the Recent Enrhquakes in Italy, 293,
Weather Cycles, 541
Organ Pipes, the Energy used by, C. K. Weid, 310
Organ Chemistry, Practical Work in, Fredk. Wm. Streatfelld,

Organic Chemitary, Treats was Streament, Organic Chemitary, Terat was Streament, Organic Maria Charles, P. R. S., on some Points in the Early History of Autonomy, 8, 57, 107, 199
Ormarol (Mish, Requantion 6, 481, 582). Cock, S. E. Peal, 30, F. H. Cross, 151, Antipubly (f) of Brock for Colour, 11, Annual Meeting of the German Ornithological Sucrey, 39, Birds netting in Western India, Licationals H. I. Barnes, 421 the Soung of Birds, S. E. Peal, 56, A. C. Binnes, 421 the Soung of Birds, S. E. Peal, 56, A. C. Binnes, 421 the Soung of Brids, S. E. Peal, 56, A. C. Binnes, 421 the Soung of Brids, S. P. Legis, S. C. Binnes, Lake Victoria Nyanas, Emin Pasha, 87, Vicana International Ornitological Congress, 113, the Encuronous Birds of Ornitological Congress, 123, the Green Sounger, 114, 18, 161, Nevis and Eggs of Cathord, Australas, A. I. North, 207, Net and Eggs of Cathord, Australas, A. I. North, 207, Net and Eggs of Cathord, Australas, A. I. North, 207, Net and Eggs of Cathord, Australas, A. I. North, 207, Net and Eggs of Cathord, Australas, A. I. North, 207, Planar Eradons of Birds Poot, 303, the Destruction of Argyll, Planar Eradons of Birds Poot, 303, the Destruction of Planar Eradons of Birds Poot, 303, the Destruction of of Naural History Massem to illustrate Variations to Deep Planar Feadour of Bird's Foot, 99, the Deveration of Small Birds in France, 399, Additions to Bird Department of Small Birds in France, 399, Additions to Bird Department Albarross, Sir Walter Buller, F. R. S., 502, a Remarkable Characteristic of the Wanfer gird Albarross, Sir Walter Buller, F. R. S., 503, the Find Collections in the Oxford Diriversity Museum, 502, the Bird Collections in the Oxford Diriversity Museum, Dr. P. J., Solater, F. R. S., 518, Water Burds that Jure in Dr. P. L. Sciater, F. R. S., 518, Water birds that Live in the Woods, G. B. Sennett, 529, Sparrows and I fawk in New Zealand, T. W. Kirk, 529, a Wild Duck's Forcthought, W. Prentis, 550

Orrery, Messrs, Philip and Sons' New, 501
Ostrich in Nesting Season, Pagnacity of Male, James Andrew.

Ostwald (Wilhelm), Outlines of General Chemistry, 561 Oviparous Species of Peripatus, Arthur Dendy, 468, Prof. A

Osparous Speeces of Peripatus, Arthur Dendy, 468, 1761. A Sedgawick, P. R. S., 464.
Oxford University of, Intersect Accommodation for Medical Prof. Prior Pr

H. Junelle, 210
Oyster Disease and its Remedies, Mr. Fryer, 233
Oyster Fisherise, Mr. Fryer, 233
Oyster, Mud, of New South Wales, 437
Oysters and all about them, John K. Philpots, the
Oysters and all about them, John K. Philpots, the
2 Popular Summary of a Scientific Study, Prof W. K. Brooks, 490

Pacific Postal Telegraph Company, Opening of a New Tele-

Pacine Pottal religion Company, Opening of a New Year-graph Office at San Francisco, 231 Packard (Dr Alpheus S.), Fifth Report of the United States Entomological Commission, 217 Paddling, Effect on Development of Arms and Chest, J. J.

Lister, 476
Paddy in Japan, Manuring Experiments with, Dr. O. Kellner,

353
Padelletti (Prof.), on the Insufficiency of the usual Investiga-tion for Movement of Plane of Oscillation of Foucault's Pendulum in Relation to Farth's Rotation, 326

Pendulum in Keiation to rain's Kotation, 320
Paget (Charles E.), on Diphithera, 369
Pahang, Straits Government Scientific Expedition to, 112
Palaxography, Copite, Album de Paléographe Copte pour
servir à l'introduction Paléographique des Actes des Maxtyrs

servic a i introduction Fraeographique des Actes des Martyrs de l'Egypte, Henri Hyvernat, 609
Palæontology the Fosul Insects of North America, with Notes on some Fuiopean Species, by Samuel II. Scudder, R

on some Figure 1962, by Sainter 11. Schooler, K. Lydekker, 1982, Lydekker, Palestine Exploration Fund, 576
Palestine Exploration Fund, 576
Palmer's (Dr.) Botanical Collections in Western Mexico and Arizona, 528 Paniab, Craniometry of Outcaste Tribes of, Dr R H, Charles,

576

Pantellaria, Farthquakes at, 599
Punelin (M), Incandescence of Platinum Wires under Water, 512

Parcels Delivery, Underground, A R Bennett, 510
Pareinvaurus, Researches on the Structure of, Prof H G

Parensaurus, Researches on the Structure of, Prof. H. G. Sceley, P. R.N. 90, 20 sensor, 3, 48, 72, 96, 110, 144, 168, 119, 216, 240, 96, 287, 91, 11, 335, 300, 391, 410, 440, 644, 644, 645, 151, 256, 56, 564, 606, 591, Annual Report of the Paris Observatory, 70, Extraordinary (Esphone Accident Paris Pa

cine, 351, Annales of the Central Melcorological Office, 389

cine, 351. Annaes of the Central Meteorological Unice, 369
Parka designess, the Foods, 165
Parker (Prof. 1 Jeffery, F.R.S.), Lessons in Elementary
Biology, Prof. F. Ray Lankester, F.R.S., 200
Parker (Prof. W. N.), on Respiration in Indipules, 482
Parker (Prof. W. N.), the Climate of Cephaloma, 320

Parcoe (Francis P), the Darwinian Theory of the Origin of

Water, 264 Pekelharing (Heer), on a Substance analogous to Fibria Ferment contained in Magnesium-Sulphate-Plasma or kalium-

Oxalate-Plasma, 288

Pelzeln (August von), Death and Obituary Notice of, 500 Penfield (5 L.), the Minerals in Hollow Rhyolite Spherulites,

Periodic Comets, Physical Appearance of, E. E. Barnard, 551 Periodic System, a Text book of Chemistry based on the, William Ramsay, F. R. S., 50

William Ramsay, F. R. S., 50
Pernpatus, Ovparous Species of, Arthur Dendy, 458, Prof. A.
Sedgwick, F. R. S., 494
Perkin (Dr. W. H., F. R. S.) Refractive Powers of Certain
Organic Compounds at Different Temperatures, 287; Society
of Aris Albert Media for 1890 presented to, 30
Perley (Mr.), on Old time Winters in Essex County, Massa-

ehusetts, 353
Perman (E. P.) and Prof. W Ramsay, F. R. S., on an Attempt

Personn (E. F.) and Froi, w. Annany, F. K. 5, on an Attempt to determine the Adiabatic Relations of Ethyl Oxide, 22
Personcito (Prof.), Tuberculosis, 397
Perrotin (M), Partial Eclipse of Sun, June 6, 1891, 168
Perry (Prof. J., F. K.S.): Blakesley's Method of Measuring

Power in Transformers, 142, Quadrant Electromaters, 166; Illiastrations of C S. System of Unias, with Tables of Persulphates, M. Berthelot, 420, D. Marshall, 577 Persulphates, M. Berthelot, 420, D. Marshall, 577 Peternanni Muteslangen, 630
Peters and State's Exploration in Egypt, 630
Peters and State's (Mean's) New Electrical Light, 327
Peters and State's (Mean's) New Electrical Light, 327
Peter (Flwin), Howards Minderers, 477

Petrot (Ivan), the Nunivak Islanders, 477
Petroleum, on the Origin of, W Topley, F R.S., 479
Petroleum Engines, Prof. W Robinson on, 509
Petrology, an Introduction to the Study of, Dr Frederick II
Hatch, 25

Pharmacology, Supplement to I)r Lauder Brunton's 1ext-book of. 41

Phenomenon, a Rare, Arthur Marshall, 519, W Tuckwell 519; F. C Levander, 519, Herbert Riv, 541, D. J. L. E. Dreyer, 541

Phenomenon, Unusual Frost, A II White, 519
Philadelphia, Academy of Natural Sciences of, 252

Philadelphia, Academy of Natural Sciences of, 353
Philip and Son's, New Orrery, 501
Philip not (Dr.), Mountain-climbing in Greece, 599
Philology - the Posttion of the French Accent, Dr. Pringsheim, 67; Vocabularies from the Musquito Cossi, Dr. D. G.

67; Vocacularies from the attachmic Community Brinton, 600 Philipot (John R.), Oysters and all about them, 490 Phonometer, a New Form of Chronograph, W F Stanley, 239 Phosphorus Chloroflooride of, A E Tutton, 333, the Ex pantion of, A Leduc, 360
Photo-Stellar Spectra, Rev. Dr T F Espin, 133, Prof

patients of the Accoust Spot Dr. T. F. Espin, 133. Prof. Edward C. Fischering, 233. Prof. Edward C. Fischering, 233. Photocraphy Evening Work for Amatum Photography. The Photography Sevening Work for Amatum Photographys. C. Co. Workship, 34. Photography as an Austimy to Praning, C. Co. Workship, 34. Photography as an Austimy to Praning, C. Co. Workship, 34. Photography Frind, K. Melshola, F. R. N., 194. Photographus Councily of Great Brisan, Annual Exhibition of, 341, some Applications of Photography, Lord Multimor, 1941, some Applications of Photography, Lord Multimor, 1941, some Applications of Photography, Lord Photographic Professional Photographic Professions, 1945, Photography of Rapid Movements, Anachutés, 352. Photography of Bagud Movements, Anachutés, 352. Photography of Bentinon, A. Millock, 552. Photograph

370

'hymosoma weldont, 21

370

Physical Society at Cambridge, 1797

Physical Society at Cambridge, 1797

Physical Society at Cambridge, 1797

Physical Society, 142, 237, 267, 166. Physical December of a Whrling Ring, Class. A. Carus-Wilson, 31, C. Chree, 82, Cottages Society, 142, 237, 267, 167. Physical Society, 6, 167, 179. Physical Society, 6, 167, 179. Physical Society, 6, 176, 179. Physical Society, 179. Physical Society, 6, 176, 179. Physical Society, 179. Physical Society, 179. Physical Society, 179. Physical Ph Stokes, 463, the Measurement of Hardness in Transparent Bodies, Prof. Auerhach, 282; the Expansion and Compressibility of Aurospheric Air, A. W. Wukowski, 312, the Swelling of Plates of Gelatine in various Solutions, Herr Swelling of Plaics of Gelatine in various Solutions, Herr Hofinenier, 336, Incandescence of Platinum Wies under Water, M. Paquelin, 512. Prevaire which can be produced by Electrolytic Generation of Ga. M. Chabry, 577; Physical and Technical Institution at Berlin, 154; Physical Observa-tion of Particular at Southenian Institution, 56; Physical 600; Established at Southenian Institution, 56; Physical 500; Particular Southenian Southenian Computer Southenian 227; Physical Religion, F. Mas Muller, 219; J. Woodd

Smith, 249, Name for Resonance, Prof. Oliver J. Lodger F.R.S., 248, Physiciston Colour vision, Capit Abney, F.R.S., 313, Sir William Thomson, P.R.S., on some Test Cases fo the Maxwell-Holtzmann Doctrine regarding the Distribution the Maxwell-Holizmann Doctrine regarding the Distribution of Energy, 355, Opening Address in Section A at the Meeting of the British Association, by Prof. Oliver J. Lodge, F R S., 382, Physics at the British Association, 453, W. E. Wilson on the Absorption of Heat in the Solar At-W. E. Wilson on the Absorption of Heat in the Solar At-mosphere, 433, Prof Oliver J. Lodge, F. R. S. on shether the Lither behaves as a Viscous Fluid, 444, Prof D. E. Jones, on Electric Wassen in Vires, 444, Dr Johnson Stoney, Oliver J. Lodge, F. R. S., on Light in Modifying the Effect of the clavatistional Attraction of the Sun, 454, Units and their Nomenclature, 454, Prof S. P. Hompson, F. R. N., on the Measurement of Lemes and on a New Yolarmer, 455, P. 7. Trouton on the Propagation of Magnetization in Iron, 455, on the Functions and Nature of the Ether of Space, Prof. I

xxvii

Reports of the Royal College of Physicians of Fubburgh, Vol III., J George Adam, 73, Organe Bases in juste of College of the Change of the Change of the Change of the Change of Physician College, 135, White College, 135, Wheeler Strength Diminished by Alcohol, MM Grehant and Quanquaud, 135, the Development of the Luver of Noubranchites, II. Fi-cher, 44, Physiological Physiology, 10 Th. Feben, 135; Displacements of Heart and Cardy Dr. Th. Change of the Change o 180, the Later Larval Development of Amphioxis, Artnur Willey, 202, Mr. Francis Gotch appointed Professor of Physiology at University College, Liverinol, 257, Vegetable and Annual Cells, Dr. J M McGarlane, 263; the Growth of the Face, Prof. 6 M. West, 325, a Case of Periolical Skim-Stedding, Di. J. Frank, 477, Harvey's Discovery, D. Dickinson, 597 Physique, 137

Picart (L), Brook's Comet, 1890 II, 168

Preast (L.), Brook's Comet, 1890 II, 168

Pickering (Frof. E. C.) the Spectra of Double Stors, 138, Stars having Peculiar Spectra, 305, 438, the Draper Catalogue, 223, Spectrum of 8 Lyre, 335

Pickering (S. U.) Nature of Solutions as Elucidated by Study of Dematics, &c. of Solutions of Calcium Chloride, 215, Note on a Recent Criticism by Mr. Lupton of Conclusions. rouse on a recent Criticism by Mr. Lupton of Conclusions drawn from Study of Sulphure Acid Solutions, 215
Pulgeon (W. R.), Raut-making, 565
Pageon (Léon), Two New Crystalline Compounds of Platine
Chloride with Hydrochloric Acid, 120

Chiorde with Hydrochioric Acid, 120.
Pihl (O A L), the Stellar Cluster x Perset, 259.
Pilchard, on the Reproduction of the, J T Cunningham, 48t.
Pilot Chart of North Atlantic, 281, 501, 575.
Pines and Firs of Japan, Dr Maxwell T. Masters, F R S.,

339 Pink Marine Micro organism, Prof W A Herdman, 565

Pistor (Dr.), Ueber die Desinfection, 487
Plane Trigonomeiry for the Use of Colleges and Schools, L.
Todhunter, FRS, 342 Plants, Francis Darwin, F.R.S., on the Artificial Production of Raythm in Plants, 484
Plants, Growth-Curvature in, Francis Daiwin, F R S, 407

Plants, Sleep Movements in, A. G. Tausley, 493.
Plants, Water taken up by, Phenomena associated with Absorption and Flow of, Walter Gardiner, F.R.S., 188.
Platinum, Crystals of, J. Joly, 124.
Platinum, Volatile Carbonyl Compounds of, Drs. Pallinger,

Mylius, and Foerster, 530
Playing Cards, Japanese, Mrs. Vau Rensselaer, 162
Pneumatic Bridge, on some Measurements with the, W N.

Phenometry of the Scorpions at the Zoo, 198
Pocock (R. I.), the Scorpions at the Zoo, 198
Pocock (R. I.), the Scorpions at the Zoo, 198
Pocock (R. I.), the Scorpions at the Zoo, 198
Madras Observatory, 383; Memoral to, 436
Poincaré (Prof.), on Maxwell's Electro magnetic Theories,
Company of States and Snake, Dr.

Mueller, 162
Pola and Trieste Harbour-, the Mareograph in, Lieutenart

Gratzi, 600 Polak (Dr. Eduard), Death of, 629

Polarization Theory of the Solar Corona, Prof Frank H Polatization steem, v. Bigelow, 35 Bigelow, 35 Polatizer, Prof. S. P. Thompson, F.R. S., on a New, 455 Poloten Hills, Geological Formations Fiposed in Bridgwater Railway Cuttings through, J. T. M. Clarke, 530 Pole (Dr. William, F.R. S.), a New Keyed Musical Instrument

Pole (Dr. William, F. R. S.). New Kypel Missell instrument for Just Intolation, 460.
Political Economy, Dictionary of, 564.
Polyson, Nature of Exercitory Trocsses in Manne, S. F. Pomel (M.), the Loccue Formations of Algeria, 264.
Pomel (M.), the Loccue Formations of Algeria, 264.
Population and Disease, Studies in Statistics, George Blundell Demography, 48.
Polyson Statistics, 1997.

Longutar, 4

Longutar, 4

Longutar, 4

Longutar, 5

Longutar, 7

Longutar, 8

Longutar, 9

Longu

Postive Science and the Sphinn, 315
Positive N. Chairwation of, 307
Positive (M. C.), Diseases of Goos and Lexi, 167
Positive (M. C.), Diseases of Goos and Lexi, 167
Positive (C.), Sciences Compound, Pho phorus Pentaflacohloride, 288
Powell (Major J. W.). Map Coloning and Cartography, 506,
on Indian Language, 311
Power, Electric Transmission of, J. J. Murphy, 500
Pograting (J. H., F. R. S.), so a Determination of Mean Density
Research (G. Carvattania Constant by Means of Common
Rabace, 166

Balance, 165
Prain (Dr D.) · New Indian Labiatic, 258; and the Investigator

Cruise, 549
Prausnitz on the Existence of the Bacilli of Tuberculosis in Railway Carriages, 390
Precec (W. H., F.R. S.), on the London and Paris Telephone, 510

Prehistoric Monuments in France, the Protection of, 232 Prentis (W.), a Wild Duck's Forethought, 50 Preston (Rev. T. A.), Na ural History in Public Schools, 137 Preventive Medici, e, the British Institute of, 86, 97, 111, 124,

135: 184
Prent (F.), the Evolution of Anmals, R. Lydekker, 243
Prentley (Dr. W. O.), on the Improved Hygenic Condition of Maternity Hoppuls, 465
Printlive Man and Stone Hammers, J. D. McGuire, 630
Printlive Man and Stone Hammers, J. D. McGuire, 630
Printing, "Photography as an Auxiliary to, Leon Violat, 136
Print (Dr. R. A.), the Spiked Star of Bethleen(O mithogalism pyrenaicum), 215

Prism, Refraction through a, Rev. John H. Kirkby, 294
Prisms, Liquid, Prof. W. N. Hartley, F. R. S., 273
Pritchard's (Prof.) Rejoit on Oxford University Observatory,

Proceedings of Academy of Natural Sciences of Philadelphia,

548 Proceedings of the Royal Society of Canada, 477
Probaska (Prof.), Study of Remarkable Series of Hadstorms at

Graz, 233
Protective Device of an Annelid, Arnold T Watson, 507 Protoplasmic Rejuvenescence, Prof. Marcus Hartog, 483
Prodobamne (M.), Cotton Bleaching by Oxygenated Water
with Calcined Magnesia, 192
Prasia, Damage to State Buildings by Lightning, 1877-86, 501

Psychology, Physiological, Dr Th. Ziehen, 145 Psychrometer, the Aspiration, and its Use in Balloons, Dr. R. Assmann, 512

Pujazon (Captain Cecilio), Death of, 17
Pulfrich (Dr. C.), Das Totalreflectometer und das Refractometer

Pullrack (Dr. C.), Das toutenecomerer unu un variante de für Chemiker, 538
Pullinger (W.) * Volatile Platinum Compounds, 215; Volatile Carbenyl Compounds of Platinum 530
Pulse Curves, Five Years, F. H. Perry Coste, 35
Pardic (T.) the Addition of Alcohol Elements to Ethereal Salts of Unsaturated Acids, 118

of Unsaturated Acids, 118
Pyenogomds, or Sea-Spiders, 49
Pyrenees, the Flowers of the, and their Fertilization by Insects,
Pyrometer, Prof. Roberts-Austen, F R S, on his Self-Acting,

Quarterly Journal of Microscopical Science, 21 Quarterly Journal of Royal Meteorological Society, 599 Quaternions and the AusJehnung-lehre Prof J Willard Gibbs, 79, Prof P G last, 105 Quancke (F) a Volatile Compound of Iton and Carbonic

Oxide, 234, Iron Carbonyl, 304 Quinquaid (M), Musc dar Strength Diminished by Alcohol,

Races and Peoples, Dr. Dantel G. Britton, 124 Rednan Hen, Massacraptic O. Lunar, 577 Rodiant Sunlight, Competion between Terrestrial Magnetism and, Prof. F. H. Bigclow, 437 Rac (W. Fisser), the Busine-v of Travel, 247 Rallroad-Tex, Chemical Methods of Protecting against Decay,

O Chanute, 476
Railway Train Lighting, William Langdon, 41
Rain Gauges. Thomas Fletcher, 371. G. J. Symons, F.R.S.,

398

Ram Making in Texas, 436, 473, Prof. George E Curtis, 594, in Florida in the Fifties, 521, W. R. Pidgeon, 595, Dr. Halo Gogliol, 590, Freprincells, 614, Rambow, a Lanne, Dr. P. V. Keegan, 591

Charles Todd, 501

Rambow, a Lanne, Dr. P. V. Keegan, 591

Charles Todd, 501

Rambow, Charles Common with Regard to, 510

Rake (Ds.), Leprosy theniles cultivated in serum by, 161

Rambow, Prof. W. F. K. S.) and E. P. Perman, on an Attempt to determine the Adabatic Relations of Ethyl Oxide, 23;

a System of Tonogenic Chemistry, 50, the University of a System of Tonogenic Chemistry, 50, the University of Rambow, 51

Rambow, 181

Rankın (A.), the Winds of Ben News, 191
Randome (Dr. Arindri), on the Prevention of Consumption, 369
Rapakırı, the, J. J. Secterbolm, 548
Rapakırı, the, J. J. Secterbolm, 548
Rapakırı, the, J. J. Secterbolm, 548
Rapakırı, the, J. W. Pickevell, 1919, F. C. Levendre, 1910. Herbert Rix, 541, Dr. J. L. E. Dreyer, 541, W. Duppa Crotch,
542, Prof. W. N. Hartley, F. R. S., 544
Rapakıl on the Destruction of Small Birds in Prance, 359
Rapakıl on the Destruction of Small Birds in Prance, 359
Rapakıl on the Destruction of Use, 110 Arithat Kolmson,
Rat and Mouse, the Development of the, 110 Arithat Kolmson,

n433. Alon, Vorecty of Caytan B. Lujsh, 600
Ravenstein (E. 0), the Field of Gregorius, 423
Rayet (G.) Brook's Comet, 1850 II, 168
Rayleigh (Lond, F.R.S.); the Faraoy Centenary, 178, some Applications of Photography, 269, Van der Waals's TreatApplications of Photography, 269, Van der Waals's TreatRayleigh (Lond, 49, 499, 597)
Ressoning, 4 pruss, Prof. George Hendlow, 324
Ressoning, 4 pruss, Prof. George Hendlow, 260
Ressoning, 4 pruss, Pruss, Prof. Ressoning, 4 pruss, 260
Ressoning, 4 pruss, Pruss, 260
Ressoning, 4 pruss, 2

10. 161

Rectorite, a New Mineral of the Kaolinite Group, R. N. Brackett and J. F. Williams, 310
Reed (Sir Edward), on the proposed Channel Tubular Railway,

509 Refraction through a Peism, Rev. John H. Kirkby, 294

Refrigerator, an Automatic, 390
Regel (He.r.), Influence of External Factors on Smell of Plants.

Rend (Clement), the Origin of the Flora of Greenland, 299 Reimann (Prof), Apparent Flattening of the Vault of the

Heavens, 67 Rein (Prof.), Acclimatization of Japanese Lacquer tree at Frankfort, 500

Religion, Physical, Prof F. Max Muller, 219, B. Woodd Religion, Physics, 1701
Smith, 249
Smith, 249
Rennselaer (Mr. Ne.), Japanese Playing-cards, 162
Rennselaer (Mr. Ne.)
Research on the Structure of Parenasaurus,
Politic Sceley, 187, 83, 198
Research, Endowment of, in France, MM Cahours and Janssen,

Resonance, Name for, Prof Oliver J. Lodge, F.R S., 248 Reuna, Oscillations of the, A. Charpenter, 311 Retinite, the So called Amber of Cedar Lake, B. J. Harrington,

584
Reuss (Dr. von), Hygienic Advantages of Erect as compared with Slanting Writing, 125

REVIEWS and OUR BOOK SHELF :--

Fossil Insects of North America, with Notes on some Euro-pean Species, Samuel H. Scudder, R. Lydekker, I Studies in Statistics, Geo. Blundell Longstaff, 4

Studies in Statistics, Geo Blundell Longstan, 4
The Best Books, a Contribution towards Systematic Bibliography, W. Swan Sonnenschein, 5
Fairyland Tales of Science, Rev. J. G. McPherson, 5
Aids in Practical Geology, Grenville A. J. Cole, Prof. A. II

Green, F.R.S., 25 An Introduction to the Study of Petrology, the Igneous Rocks, Frederick H. Hatch, Prof. A, 11 Green, F.R.S.,

Les Virus, Dr. S. Arloing, 27
Anleitung zur Bearbeitung meteorologischer Beobachtungen für die Klimatologie, Dr. Hogo Meyer, 27
Intentily Colis, how Made and how Used, "Dyer," 28
General Physiology, Camilo Callen, 28
Die Norske Nordhave Expedition, 1876–78, 49

Den Norske Nordhavs Expedition, 1876–78, 49
Studies from the Biological Laboratory, John Mopkins University, Baltimore, a Convibution to the Embryology and Phylogeny of the Prenoponidy. T If Morgan, 49
System of Inorganic Chemistry, W. Ramsay, F. R. S., 50
Eighteen Years of University Extension, R. D. Roberts, 52
Evening Work for Amateur Photographers, T. C. Hejworth,

Evening work in America, 60 Del Wild in dee Vermingten Staten von Nord America, 60 Laboratory Reports of the Royal College of Physicians of Leinburgh, 1) George Adamy, 75 Examen Quimico y Bacternológico de las Aques Potables, A E Salatar y C. Newman, 74 Botany, a Concide Manual for Students of Medikan and Canana. Alse, 10 Inhanton, 75

notany, a College manual for Students of Medicine and Science, Alex Johnstone, 75 Hand-book of the Ferns of Kaffrana, T R Sun, J G. Baker,

F R.S , 75 F R.S., 75 Rider Papers on Euclid, Rupert Deakin, 76 Die Krystallanalyse oder die Chemische Analyse dierch Beo-hachtung der Krystallbildung mit Hilfe des Mikroskops mit theilwiser Benutung seines Buthes über Molekular-

physik, 76 Grundruge der Geologie und 1:hysikalischen Geographic von Nord-Syrien, Dr. Max Blanckenhorn, Prof. Edward Hull,

F.R.S., 99 Plantæ Europeæ, K Richter, J G Baker, F R.S., 100

Missouri Botanical Garden, 101
Géologie, H. Hermite, 102
Webster's International Dictionary of the English Language,

Elementary Chemistry for Beginners, W. Jerome Harrison,

Examination of Water for Sanitary and Technical Purposes, H. Leffmann, 103

httroduction to the Study of Mammals Living and Extinct, W. H. Flower and Richard Lydekker, Prof. E. Ray Lankester, F.R.S., 121 Forty Years in a Moorland Parish, Rev J C. Atkinson, 122
Anatomy, Physiology, Morphology, and Development of the
Blow fly (Calliphera crythi ocrphala), B. Thompson Lowne,

Races and Peoples, Lectures on the Science of Ethnography,

D. G. Brinton, 124 Lettfaden der Physiologischen Psychologie, Dr. Th. Ziehen,

145
Achievements in Engineering, L. F. Vernon-Harcourt, 147
Geologius' Association, a Record of Excursions made between
1860 and 1890, 149
Across East African Giaciers, an Account of the First
Ascent of Killmanurc, Dr. Hans Meyer, 149

Chemistry in Space, 150
Differential and Integral Calculus, with Applications, Alfred
George Greentill, F.R. S., 170
Geology of the Country around Laverpool, G. H. Morton,
Prof. W. Hoyd Dawkins, F.R.S., 172
Les Microbes, les Ferments, et ses Mosis nics, Dr. E. L.

Trouessart, 173 Botanical Wall Diagrams, 173

Botancal Wall Diagrams, 173 Chamber's Freychyadta, 175 Climpter of Nature, Andrew Wilson, 174 Elements of Cryallography for Students of Chemistry, Physics, and Mineralogy, George Hustingdon Williams, Fred J W Jadd, F.R. S, 193 Photographic des Couleurs par la Methode Interferentiele de M. Lippnann, Alphome Berget, Frod R. Mellola, F.R. S, 18

Geometry of Po ition, R. H Graham, Alex Larmor, 195 Species of Epilobium occurring North of Mexico, Dr Trelease, 196

lease, 196
Guute Book to Books, 196
Tasamanus Official Record, 1891, R. M. Johnston, 196
De Pyrenecubloemen en bare bevruchting door Insecten,
Prof J. MacLeod, 211
16th Report of the United States Entomological Commission
on Insects injurious to Forest and Shade Trees, Alpheus

S Packard, 217

on Insect Highroot to Forest and Small Feey, Applied Physical Religion, F. Max Muller, 219
Das Karsendelgebinge, A. Rothlylett, 221
History of Commerce in Europe, II de Gibhan, 222
History of Commerce in Europe, II de Gibhan, 222
History of Commerce in Europe, II de March l'Appaintion de II Homme, P. Preim, R. Lydckker, 243
Leyons sur les Meinst, Prof. Alfred Ditte, Prof. W. C. Roberts Austen, F. R. 3, 245
Tratif Pratique de Chew. C. Hobeits Austen, F. R. 5, 245
Recters and ther Products, Sams Woodhead, 240
Our Country's Prover, W. J. Gordon, 247
Summary of the Darwinsin Henry of the Origin of Species, Francis J. Piacco, 247 fty, Vean' Record of Progress, W. Frast Res, 247
Piraser Res, 247

Fraser Rae, 247 Manual of Forestry, W Schlich, Sir D Brandis, F R.S.

265 Dictionary of Applied Chemistry, Sir H E Roscoe, F.R S.

268 Faune des Vertébrés de la Sausse, Victor Fatio, Dr Albert Gunther, F R S, 269
History of Human Marriage, Edward Westermarck, Prof. W.

Robertson Smith, 270
Geological Map of Monte Somma and Vesuviu, H. J. Johnston Lavis, 271

Johnston Laws, 471
Los Sciences Naturelles et l'Éducation, T. H. Huxley, 272
History of Chemistry from the harbest Times to the Prescui
Day, Ernst von Meyer, Prof. T. E. Thorpe, F. R. S.,

l essons in Elementary Biology, T. Jeffery Parker, Prof E Ray Lankester, F. R. S., 290 Crooman Lectures on Cerebral I ocalization, David Ferrier,

Education and Heredity, J. M. Guyau, 292
The Soul of Man, an Investigation of the Facts of Physiological and Experimental Psychology, Dr. Paul Carus, 293 iogical and Experimental Expensions, 10 F and Ostral, 293 Electricaté et Optique, H. Poincaré, Prof. A. Gray, 295 Colour-Measurement and Mixture, Captain Abney, 313 Riddles of the Sphinx, a. Study in the Philosophy of Evolu-

Kunnes of the Sphurs, a Study in the Philosophy of Evolution, by a Troplodyte, 315
Proceedings of the Association of Official Agricultural Chemists, 1890, 317
Hand-hook of the London Geological Field Class, Prof. H. G. Seeley, F. R. S., 317
Kanlog der Bibliothek der Deutschen Setwarte zu Hamburg,

clentific Results of the Second Yarkand Mission, based upon the Collections and Notes of the late Ferdinand Stoliczka,

na Concertons and Notes to the State of State of

Solutions of Examples in Elementary Hydrostates, W. H.
Plane Trapprometry for the Use of Colleges and Schools,
I. Todhuster, F. R. S., 32
Lessons in Astronomy, C. A. Young, 342
Lessons in Astronomy, C. A. Young, 342
The Telescope, an Introduction to the Study of the Haevens,
J. W. Williams, 322
The Telescope, an Introduction to the Study of the Haevens,
J. W. Williams, 322
The Telescope, and Introduction to the Study of the Haevens,
J. W. Williams, 322
The Telescope, and Introduction to the Study of the Haevens,
J. W. Williams, 322
The Telescope, and Introduction to the Study of the Haevens,
J. W. Williams, 322
The Telescope, and Introduction to the Study of the Haevens,
J. W. Williams, 322
The Telescope, 323
The Telescope, 324
The Telescope, 3

Science or Romance, Rev. John Gerard, Prof R Meldola,

Science of Romance, Rev. John Gerard, Prof R Meldola, F.R. S. 44
Laws of Force and Motion, John Harrs, 443
Laws of Force and Motion, John Harrs, 443
An Introduction to the Mathematical Theory of Electricity and Magnetism, W. T. A. Emisge, 443
Magnetism, W. T. A. Emisge, 443
Let all Somethies of the Control of Electricity and Magnetism, W. T. A. Emisge, 1999
Elementary Science Lesson, W. Hewitt, 444
Solutions of the Examples in Charles Smith's Elementary Algebra, A. G. Grack-Indi, 444
Offine The Control of Contro

Telescopic Work for Starlight Evenings, W. F. Denning. Abbildungen zur Deutschen Flora H. Karsten's, nehst den

auslandischen medicinischen Pflanzen und Erganzungen für das Studium der Morphologie und Systemkunde, 46 Elementary Text-book of Botany for the Use of Schools,

Elementary Text-Dook of Botany for the Santa Tables of Edith Aitkin, 467
Illustrations of the C.G.S. System of Units, with Tables of Physical Constants, Prof. Everett, F.R.S., Prof. John

Physical Convants, Prof. Everett, P.K.5, Prof. joun Perry, F.R.5, 489 Oysters, and all about Them, J. R. Philpots, 490 The Oyster, a Popular summary of a "cienture Study, Prof. W. K. Brooks, 490 Diagon-flue versus Mosquitoes, 491 Materials for a Piora of the Malayan Pepinsula, George King,

Materias for a riora of the statement remnsula, George King, F.R.S., 492 to Tasmania, New Zealand, the Ladrone Islands, and the Philippines in the Years 1771-72, 492 I twingstone and the Exploration of Central Africa, H. II Johnston, 492

Johnston, 432
Manael Pratique d'Analyse Bactenineique des Laux, Dr Muquel, Prof. Percy, F. Frankland, F. R. S., 513
Manael Pratique d'Analyse Bactenind, F. R. S., 513
Manael, Pratique d'Analyse, Pratique J. Gragm and Method of
Spiesed, R. Skey, R. Russell, 547
Aligemene chemische Mineralogie, Dr. C. Doelter, 516
Spiesed, R. Skey, R. Russell, and A. Merchild, 514
Aligemene chemische Mineralogie, Dr. C. Doelter, 516
Spiesed, F. Stelley, R. William, A. Merchild, 514
Le Bagian, Champan, Conce, with a Chapter on the Laue
La Engian, Chinege, George-Ville, 517
The Lee Age in North America, and its Bearings upon the
Age of Manael Champan, C. Precke Wight, Prof. T. G. Bonney,
F. R. S., 337
R. J. Stan, G. Frecke Wright, Prof. T. G. Bonney,
F. R. S., 337 F R S, 537
Das Totalreflectometer und das Refractometer für Chemiker,

Dr C Pulfrich, 538 Consideraciones temperiei pro 7 annis per Magistrem Wil-helmum Merle, socium domus de Merton, G J Symons,

neimum Merie, socium domus de Merton, G J Syn F R S, 538 South Italian Volcanoes, Dr. Johnston Lavis, 539 Buried Cittes and Bible Countries, George St Clair, 540 Food Physiology, William Durham, 540 Blackies Science Readers 540 Othlines of General Chemistry, Willielim Ostwald, 567 Balletin of the United States Pinh Commission, 562

Dalletin of the United States Fish Commission, 562
Index Casislogue of the Library of the Surgeon-General's
Office, U.S. Army, Dr. A. F. Myers, 563
Dictionary of Political Economy, 564
South Africa, from Arab Domination to British Rule, 564

Flectric Light Fitting, John W Urqubart, 586
County Councils and Technical Education, I. C. Buckmaster.

588
Missouri Botanical Garden, Second Annual Report, W

Trelease, 588
The Story of the Heavens, Sir Robert Stawell Ball, 589 The Story of the treavess, 3ir Robert Stawell 18st, 599 Notes on Elementary Physiography, Horsec C, Martin, 589 Thomas Sopwith, F.R. S., with Excepts from his Diary of Fifty-seven Years, B, Ward Richardson, F.R. S., 590 Album de Pafeographe Copte, pour servic à l'Introduction Paleographique des Actes des Martyrs de l'Egypte, Henn Paleographique des Actes des Martyrs de l'Egypte, Henn Hyvernat, 600

Systematic List of the Frederick E. Edwards Collection of Systematic List of the Frederick E. Edwards Collection of Bruish Oligocene and Eocene Mollusca in the British Mu-eum (Natural History), Richard Bullen Newton, 610 Memorials of John Gunn, being some Account of the Cromer Forest Bed and its Fo-sil Mammalia, 612

Forest Bed and its Fossi Mammalia, 612
The Melanesians, Studies in their Anthropology and Folk-lore, R. H. Codrington, 613
Guide to Examinations in Physiography, and Answers to Questions, W. Jerome Harrison, 613

Revue Scientifique, 324
Reynolds (J. E., F.R. S.), New Addition Compounds of Thiocarbamide affording Evidence of its Constitution, 118
Rbætic bection at Pylle Hill, Bristol, E. Wilson, 94

"Bulleting of Strongholi, 230;

Riccò (Prof A) a Recent Eruption of Stromboli, 280;
Periodic Variations of Latitudes of Solar Prominences, 360.

Richardson (A.), Decomposition of Silver Chloride by Light. 118

118 Richardson (Dr. B. Ward, F.R.S.), Thomas Sopwith, F.R.S., with Excerpts from his Diary of Filty seven Years, 590 Richmond (H. W.), Pascal's Hexagram, 191 Richher (K.), European Botany, Vol. 1, J. G. Baker, F.R.S.,

100

100
Richter on the Variation of Alpine Glaciers, 389
Riddles of the Sphinx, by a Troglodyte, 315
Ridewood's (G) Disections in Natural History Museum
Intrance Hall to illustrate Variations in Deep Plantar

Tendons of Bird's Foot, 303
Riggenbach Burckhardt (Prof A.), Earthquake of June 7, 151

Rigerback: Barckhardt (1745 A.), Earthquake of June 7, 151 kingolf Salke in the Sea, Occurrence of tire, J. Cowpert, 541 Rix (Hell-lert), a Rare Phenomenon, 541 Rix (Hell-lert), a Rare Phenomenon, 541 Rix (Hell-lert), a Rare Phenomenon, 542 Rix (Hell-lert), and Compared to the Compared Comp

View, 236 Robertson (Miss M W), Appointment to Resident Lectureship in Natural Science at the Royal Holloway College, 231 Robinson (D). Arthur), on the Development of the Rat and the

Robinson (D). Arthur), on the Development of the Kalland i Mouse, 487 W), on Petroleam Engines, 509 Rochard (Dr.), on the Prevention of Epidemic Diseases, 367 Rock-Sculptures in Scotland, Sir Herbert Maxwell, 350

Rock-Scaphtures in Scotland, Sir Herbert Maxwell, 350 Rock, Crystalline, of the Lizard District, Pr. K.; G. Bonry, F. K. S., and General McMahon, 22 Sept. S

Roozeboom (1)r. Il.), Soliculity of struce Urynas or anomorphisms Substance, I. R.), Soliculity of structure of Applied Chemistry, 265. Proceedings of Applied Chemistry, 265. Res. Rosaire (16. C). Bronno-Bernature of Heal Nighthol, Accomposition of Nitra-Act on Naphbol Devrates, Formation of Nitra-Keto Compounds, New Method of Preparing Nitro Derivature. Ille of Nitraeon Dioxide as Natistrial Agent, 190 Keto Compounds, New Method of Preparing Nitro Derivives, Use of Nitrogen Inoxide as a Nitrating Agent, 190 Roteh (A. I.), Mountain Meteorology, 464, 512
Rothpletz (A.), the Karwendel Alpa, 221
Rouault (Mathurm), Notice of, 68

Rousseau (G), Action of Water on Basic Salts of Copper, 336
Roux (Dr) Immunity, Natural and Acquired, 419, and Di
Metschnikoff, Tubercle Bacilli, 397

Meschnisof, Tuberice Bacili, 397
ROYAl Archboologuel Institute, 3, 305
Royal Archboologuel Institute, 3, 305
Royal College of Physiciana, 537
Royal College of Physiciana, 537
Royal College, Appointment of Miss M, W. Rolert
Royal Holoway College, Appointment of Miss M, W. Rolert
Royal Horicatural Society, 18, 575, Annual Diamet of, 184,
Esthibition, 500; Esthibition of Cone-bearing Trees, 548,
Dupthy of Autumn Foliage arranged for Zabetice Effect,

Royal Institution, Election of Foreign Honorary Members, 18, Royal Italian Society of Hygrene, Dr Thorne Thorne elected Corresponding Member, 331 Royal Meteorological Institute of Netherlands, 476 Royal Meteorological Society, 95, 239, Commemoration Danner, 183, 231

Royal Microscopical Society, 23, 142, 239 Royal Naval Exhibition, 180

Royal Observatory, Greenwich, Annual Visitation of the, 87 Royal Society, 22, 92, 117, 139, 165, 189, 212, 236, 260, Selected Candidates, 14, Servis, 45, Election of Fellows, 135; Conversatione, 187
Royal Society of New South Wales, 263, 311, 560

Royal Statistical Society, 161

Nogel Staturical Society, 716.

Royal Vetranay, College, Cenlemary of, 508.

Rubner (Herr), Dry and Moust Temperatures and Health, 66.

Runge (C), W. E. Weber, 272.

Russell (Wol), Exeminon to Alaska, 609.

Russell (Wol), Exeminon to Alaska, 609.

Russell (Wol), Exeminon to Alaska, 609.

Russell (Wol), Experimentary, 109.

Russell (Wol), Experimentary,

Sabanéeff (A), the Molecular Weight of Albumen, 358

Sabaneer (A.), the Molecular Weight of Albumen, 338
Sabanet (Paul), Silicon Selentile, 311
Saccardo (Prof.), Royal Morphological Research Prize of
10,000 france awarded by Accademia del Linece to, 257
Safety-Lamps, Apparatus for Testing Sensitiveness of, Prof
Frank Clowes, 250

St. Clair (George), Buried Cities and Bible Countries, 540

Salt Lakes, bilver Lodes and, George Satherland, 342
Sambon (Dr Lewis), Measures adopted for the Prevention of
Infectious Diseases, and their Relation to our Knowledge of Epidemics, 486

San Francisco Opening of the New Office of the Pacific Postal San Francisco Opening of the New Unice of the Facing Fusial Telegraph Company in, 231, Earthquake at, 575
San Salvador, Violent Earthquake in, 475
Sanderson (Prof. Burd in, F.R.S.), Tuberculosis in all its Rela-

Sanderson (Froi. Burt on, F. N. 2), I sucretures to an its 165-tions, 393.
Sandpiper, the Green, the Duke of Argyll, F. R. S., 274.
Sands, the Froduction of Musical Notes from Non-Musical, Cecil Carty Wilson, 322
Sanlary Association of Scotland, 527
Sargani (E. B.) and Bernhard Wishaw, a Guide Book to Books,

106

190
Sars (G O), Pycnogonidea, 49
Satellite, Jupiter's First, 631
Savage Religion, Dr. E B, Tylor, F R S., on, 511
Savage Religion, Dr. E B, Tylor, F R S., on, 511
Savalief (R), Determination of Solar Constant, 119
Candinguan Challe Fossel Fish of the 117

Saveise (R.), Determination of Solar Constant, 119
Schaeberle (Dr. J. M.), the Solar Corona, 300
Schenner (Dr.), Photographic Magnitudes of Stars, 526
Schenner (Liv.), Photographic Magnitudes of Stars, 526
Schiner (Henry), Corphiphica lacutriri, 445
Schlich (Linean), a Manual of Forestry, Sir D. Brandis, F. P. C.

F.R.S., 265 Schobben's (1)r) Lantern Stereoscope, 142

Schobberis (1)r) Lantern Stereoscope, 142
Schobberis (1)r, Richard), Death of, 65
Schools, Defective Venilation in American, Laurence Allen, 476
Schools, Susrail Ilitiony in Public, Rev T. A. Freston, 137
Scholls, Olympia and Art, Essisting, Oliver S. Dawson, 547
Schollsof, Marines and Art, Essisting, Oliver S. Dawson, 547
Schollsof, Physical Computer S. Charles and Computer Councils, 172
Schollsof, Card, 340
Schollsof, And Country Councils, 172, Be-Scholes and Art, Deastreette, and Country Councils, 173, Be-Scholes and Art, Deastreette, 182

Science and Art Department and County Councils, 17, Be-

cuest to, 17; Alterations in the Sentee and Art Department of the Sentee and Art Department of Sentee and Art Department of Sentee and Art, the Existing Schools of, Oliver S Dawson, 547 Sentee and Domestic Comfort in United States, 354 Science: alternative Science Islamentary Science Lessons, W. Harvitt, 444, Forthcoming Scientific Books, 462; American Association for the Advancement of Ado Blackie's Science Readers can

Science the Fairyland Tales of, Rev J. G. McPherson, 5 Science Museum, 63

Science Museum and Gallery of British Art at South Kensington. 37 Science or Romance, Rev. John Gerard, S. L., Prof. R. Meldola,

X Y X 1

Science or Romance, Rev John Gerard, S. J., Frot. R. Mctdotta, F. R. S., 441.

F. R. S., 241.

L., F. R. S. Porposse in the Victoria Nyanza, 124, the Australian Mareppai Mole. Notarytes typhology, 449, the Bird Collections in the Oxford University Museum, 518.

Sciater's (W. L.) Projected Collecting Expedition to Upper

Assam, 598

Scorpions at the Zoological Gardens, 163, R. I. Pocock, 198
Scotland Secondary Education in, 161, Proposed Informal
Congress at Edinburgh on Scotlish Higher I ducation, 258, Scottish Meteorological Society, 280, Rock-sculptures in Scotland, Sir Herbert Maxwell, 350, Technical Education

n, 549 Scott (Dr. D. 11), Obituary Notice of Carl Wilhelm von

Nageli, 580 Scott-Elliot (G. F.), Flowers and Insects, 488
Screw-propellers Major R. de Villami on, 510, Beaumont

on, \$10 Scudder (Samuel II), the Fossil Insects of North America, Notes on some European Species, R. Lydekker, 1 Sea, Occurrence of the Ringed Snake in the, J. Cowper, 541

Sea, Prince of Monaco's New Yacht for Study of, 359 Sea lion at Brighton Aquarium, Birth of, 185 Sea sickness, Dr. Thomas Dutton on, 10

Sea-spiders, 49
Sea-water, Measurement of Density of, Vice-Admiral Makaroff,

Seasonal Growth, Reduplication of, Dr. A. Irving, 371 Seaton (Dr. Edward), on Diphtheria, 368

Sederholm (J J), the Rapakiwi, 548
Sodgwick (Prof A, F R S), an Ovingrous Species of Peripatus,

Seeley (Prof H G, F K S), Researches on the Structure of Parerisanius, 93

Seemann (Cantain C II), on I uropean Weather Charts, 41 Seemann (Captain C. II.), on Furopean Wealiner Unarts, 41
Sersonlogy Lauthquake naar vi Paul's Rocks in the Allanic
Occan, 41, Transactions of Seismological Society of Japan,
67, the Larthquake of June 7, Prof A Ragepabach-Barde,
151, the Recent Earthquakes in Jisly, Prof J P
O'Kully, 293, the Emploin of Vessivas, Jame 7, 1891, Dc.
11 J Johnson Laws, 160, 230, 352, Earthquake at Boarne
mouth, Henry Cecil, 614

mouth, Henry Cecii, 614 Selborne Society's Magazine, 326 Sella (Alfonso), Magnetic Anomalies, 249 Senniti (G B), Water brist that Live in the Worlds, 529 Serguéyeff (S), Le Sommeil et le Système Nerveux, 444 Severe Winters, Weather Cycles and, 591 Severe Winters, Weather Cycles and, 591

Sewage, Disposal oi, C. G. moor, 450 Sewerage, G. Chaterton, 509 Shaler (N. S.). Antiquity of the Last Glacial Period, 529 Shan Siates, Manners and Customs of, W. R. Hillier, 137 Shark, the Basking, in New Zealand Waters, T. F. Cheesc-

Shark, the Hasking, in New Yorking, 1988. The Hallow of the Rayal Society, Shaw (William Naper). Proposed Fellow of the Rayal Society, 56, on some Measurements with the Premnante Bridge, 54-56, on some Measurements with the Premnante Bridge, 54-56, on the State of the Prematical Bridge, 54-56, on the State of the Prematical Bridge, 54-56, on the State of the Prematical Bridge, 54-56, on the Pr

Sherlock (Rev T Travers), Force and Determinism, 320

Shipley (A. E.), Orange Disease in Cyprus, 528 Shooting-stars, Theory of, M. Callandreau, 168 Shufeldi (Dr. R. W.), the Anatomy of the Heloderma, 294

Shaleful (Dr. K. W.), the Anatomy of the Helonderma, 294
Stam, Proposed University in, 323
Sibley (George, Death of, 629
Stemens (Sr. W.), Proposal to Utilize the Power wasted in the
Falls of Niagara 521
Signaling, Mr. C. E. Kelway's Apparatus for Marine and
George Electrical, 575
General Electrical, 575
General Electrical, 575
General Electrical, 575

Silurian and Devonian Rocks of Pembrokeshire, Dr. Ilicks, F.R S., 480

Silver, Allotropic, M Carey Lea, 584

Silver Lodes and Salt Lakes, George Sutherland, 342

Silver Lodes and Salt Lakes, George Sutherland, 342.
Silver Mineral, a New, 89.
Sim (T. R.), Hand-book of the Ferns of Kaffrans, J G. Baker, F. R.S., 73.
Sirius, Observations on the Motion of, Prof Vogel, 3555
Sirdus, Observations of the Motion of Prof Vogel, 3555
Sirdus, Observations on the Motion of Prof Vogel, 3656
Sirdoft (M.), Relative Age of Quaternary Stratum of Mont

Sliceot (181.), reliant age of the Compressibility of Skinshedding, a Case of Periodical, Dr. J. Frank, 477
Skinner (S.), the Measurement of the Compressibility of

Liquids, 94 Liquids, 94 Sky, Analysis of Light diffused by, A. Crova, 144 Sladen (W. Percy), the Zoological Station at Naples, 124 Slate (Frederick), Absolute and Gravitation Systems, 445

Slate [Frederick], Abbolites and Gravitation Systems, 45
Sleep Movements in Plants, A. O. Transley, 493
Sleich (Dr.), Freduction of Local Anasthras by Subcutaneous Jajection of Duttled Water, 249
Jajection of Duttled Water, 249
Smith's (Charley) Elementary Algebra, Solutions of the Examples in, A. G. Grackeell, 444
Smath (Willoughby), Death and Obstary Notice of, 303
Smith's Grow, R. Robertson), the Illisory of Human Marriage,
Edward Westermack, 270
Smithoman Astrony, 154
Smith

Smithsonian Institution, Physical Observatory, established at, 161 Smyth (Prof Piazzi), on Two Series of Photographs, in the Visible and Invisible, of the Violet of the Solar Spectrum, 191 Stale Poison and Strychnine, Antagonistic Action of, Dr

Mueller, 162 Snake in the Sea, Occurrence of the Ringed, J. Cowper,

5541 Sanodgrass (W), and Di John G McKendrick, P R S, Note on the Physiological Action of Carbon Monoxide of Nickel, 70

Snow-Observation in Russia, Herr Berg, 113 Snowdon, Proposal ly Sir Edward Watkin to place Electric

Snowdon, Proposal Iy Sir Edward Wakin to place Electric Light (n. 32).

Light (n. 32).

Snowderflag of Heavier Relieveys, 389.

Snowderflag of Heavier Relieveys, 389.

With Respect to Education, 144.

Soaring of Birds, A C. Bannes, 520.

Snowle d'Anthropologie de l'anis, 452.

Soneic d

Society for Preservation of Monuments of Ancient Egypt, 281 Solar Corona, Dr. J. M. Schaeberle, 300; Prof. J. Norman Lockyer, F.R.S., 300
Solar Corona, the Polarization Theory of the, Prof. Frank H. Bigelow, 355

Solar Observations from January to March, 1891, 90
Solar Observations, Prof. Tacchim, 453
Solar Parallax and its Related Constants, Prof. W. Harkness,

Solar Phenomena during First Half of 1891, Distribution in Latitude of, P. Tacchini, 488

Latitude of, F. Teschina, 488
Solar Promisences: Periodic Varantiens in the Latitude of, Prof. Reco., 391; Photography of, and their spectis, Prof. Eco., 391; Photography of, and their spectis, Prof. Ecorrono's Velocity of s. 416; Inflaence that Abertation of Light may exercise on Spectroscopic Observations of Light Prof. Prof. Oliver J. Lodge, P.R. S., on Expl. In Modifying the Effect of the Gavantational Airraction of the Sun, 452 in Colonda, John Autles, F.R. S., on the 202 of the 202 of

the, 279

Solution, Alum, Harry Napier Draper, 446, Ch. Ed. Gullaume, 540. Shelford Bidwell, F.R. S., 565 Sommel et le Système Nerveux, Le, S. Serguépeff, 444 Sondén (M.), Jastrument for Optical Comparison of Transparem.

Sonden (m.), fastrument to Spaces Communication of Sondhild Studies of Air pressure and Temperature on Summit of Dr. J. Huan, 112, Herren Elster and Gettel's Electric Observations (M.) Swan), the Best Books, a Contribution Communication (M.) Swan), the Best Books, a Contribution (M.)

towards Systematic Bibliography, 5

Sopwith (Thos., F.R.S.), with Excerpts from his Diary of Fifty-Sopaint Lines, F. A. S. J., Man. Servin Year, 590
Soul of Man, Dr. Paul Carus, 293
Sound, J. W. Gourdry on an Instrument for giving Enharmonic

Intervals in all Keys, 19
South Africa, from Arab Domination to British Rule, 564
South African Museum, Rearrangement of Lepidoptera Col-

South African Mneum, Rearrangement of Lepidoptera Col-lection by Mr. R. Timen, 20, 388 South Kensington, Art Museum at, 388 South Kensington Museum, Vitors to, 450 Space, the Conditions of, Sydney Lupton, 210 Space, Sur's Motions, A. M. Clerke, 572 Sparrows Neuting in Weeven India, Licutenant H. E. Barnes,

Sparrows and Hawk in New Zealand, T. W. Kirk, 520

Sparrows and Hawk in New Zealand, T. W. Kirk, 529
Spectrum Analysis: the Draper Catalogue of Stellar Spectra,
89, Photo-Stellar Spectra, Rev. Dr. T. F. Lespin, 133; the
Spectra of Double Siars, Prof. F. C. Pickering, 138; on
Two Series of Photographs, in the Visible and the Invisible, Two Senes of Theographs, an the Vaible and the Intralily. Of the Voice of Sofa Spearum, Prof. Parax Smyth, 191; Use of a Mondoromansphildin in Study of Ultra-voice Rays, Herr Wolker, 207; Photo-Stullar Spectrar, Prof. Johand C. Peters, Prof. Lower C. Peters, Prof. Lower C. Peters, Prof. 50.1

Spencer (Prof W B), a New Sponge Worm Parasite, 120 Spiders, Propulsion of Silk by, 30; Mimicry in, E. Heckel,

451 , Sea Spiders, 49 451, 5ta Spiders, 49 Spinning Ring, Right Rev Bishop Reginald Courtenay, 106; Prof Uliver J Lodge, F.R.S., 106 Spinus, Rudies of the, by a Treglodyte, 315 Spinus, Parties of the June 17 regulation, 315 Spinus, 2008, 120 Spinus, 120 State and Petirus's (Messra) New Electrical Light, 327

Stalactite Cavern in Oregon, Discovery of Luormous, 258
Stalactite Caves in Tasmania, Discovery of Mr Morton, 576 Standards, Old, 280
Standards, Old, 280
Standards of Weights and Measures, 280
Standards of 1758, the Discovery of the, 295
Stander's (W F.) Phonometer, a New Form of Chronograph,

239
Starlight Evenings, Telescol te Work for, W. F. Denning, 467
Stars the Irraper Catalogue of Stellar Spectra, 89, the Spectra
of Double Stars, Prof E. C. Pickering, 138, Double Star
Othernations, N. W. Burnham, 283, Double Stars, 631,
Theory of Shooting Stars, M. Callandreau, 168, the Stars,
631, Theory of condumy Stars, 20. Calisatoreau, 108, the Stellar Cluster X Perset, 259; Sixs having Peculiar Spectra, Prof. E. C. Pickering, 305, 438, Linear Arrangement of Niars, 478, Photographic Magnitudes of Siars, Dr. Scheiner, 536, Two New Vartable Siars, Rev. T. E. Lapin, 578
Starling Colours and Noises, the Use of, Alfred O. Walker,

Stas's Work in Atomic Weight Determination, 134

Statistical Congress, International, 527 Statistical Congress, International, 527 Statistics of Population and Dinesse, George Blundell Longstaff, 4 Statistics of Population and Dinesse, George Blundell Longstaff, 4 Statistics of Population and Dinesse, George Blundell Longstaff, 5 Statistics of Statistics of

92 Stefanescu (Prof Gregoire), Sur l'Existence du Dinotherium en

Koumanie, 602

Roumane, 602

Roumane, 672

Recombia (IVI.), on Quarantine, 367

Steventon (IVI.), on Quarantine, 367

Steventon (IVI.), on the Relations of the Chemung and Catakill on the Eastern Sied of the Appalachian Basin, 477

Stewart (IVI.), F.R.S.), the Relationship between Plants and Stillmane (IVI.), the Formation of Language, the Stillmane (IVI.), the Formation of Language, too Stockholm Royal Academy of Sciences, 100, 264

Stocked (IVI.) Quical Pariof & Estatesce of Suspended Matter

in Flame, 263
Stone Hammers, Primitive Man and, J. D. McGuire, 630

Stoney (Dr. Johnstone, F.R.S.), on Double Lines in the Spectra of Gases, 454 Storms, the Formation of, W. H. Dines, 95 Story of the Heavens, Sir Robert Stawell Ball, F.R.S., 589 Story-Maskelp, or (Frof N. F.R.S.), the Koh-i Nur, a Criticism, 51007-manacijn (17.5 A. K.), on Instinetive Crimmality, 511
Strajbh Hanl, a, A d'Abbadie, 444
Straits Government Seientific Expedition to Pahang, 112
Strawberry Plants and Climate, 83
Streatfeild (Frederick William), Practical Work in Organic Chemistry, 466
Stromboli, a Recent Eruption of Prof. A Ricco, 280 Stroovant (P), Personal Equation in Transit Observations, 608 Strychnine and Snake Poison, Antagonistic Action of, Dr. Mueller, 162 Medilet, 402
Studies in Statuttes, George Blundell Longutaff, 4
Sugar-ene from Seeds, the Propagation of, 631
Sugar-ene from Seeds, the Propagation of, 631
Sumpare (Dr. W. E.) Quadrant Electrometers, 166, Alternate
Current and Potential Difference Analogies in Methods of
Measuring Power, 237
Medilet Seeds of Medilet Seeds of Medilet Seeds of Medilet
Luminous Outburst observed on the Sun, 244, Sins Motion
in Stace, Miss A. M. Clerke, 572; Sun's Redustrion of Heat,
W. Goff, 468, Observations of Sun spots and Faculte, M.
Marchand, 395, Sun, xet die Solar
Sun's Seeds of Seeds 135
Sunday Lecture Society's Programme, 577
Sunday Lecture Society's Programme, 577
Sunlight diffused by Sky, Analysis of, A Crova, 119
Sunlight, Radiant, Connection between Ferrestrial Magnetism and, Prof. F II Bigclow, 433
Sunset Phenomena, Variations in, Herr Busch, 599 Survey, the Ordnance, 112 Survey, the Ordnance, 112 Sutheriand (George), silver Lodes and Salt Lakes, 342 Sutheriand (Dr. John), Death and Obituary Notice of, 302 Swenston (G. J), Colour Tests used in Examinations for Mercantile Marine, 500 Switzerjand, Eubes of, Victor Fatlo, Dr. Albert Gunther, Tacchmi (Prof.) Solar Observations, 453. Distribution in Latitude of Solar Phenomena during First Half of 1891, 488 Tadpoles, Prof W. N. Parker on Respiration in, 822 Tait (Prof. P. G.): Quatermons and the Antichabunglehre, 103; the Foundations of the Kinetic Theory of Gases, V. 310; Some Foundations of the Kinetic Theory of Gase, V. 310; Some founts in the Physics of Golf, 497, on Van der Waslis's Treatment of Laplace's Pressure in the Virnal Lquar Wasla's Treatment of Laplace's Pressure in the Virial Equa-tion, in naiver to Lord Raysligh, 426, 637 Tamana Sea, 371 Empediam, Mrs. L. A. Meredith, 517, Dis-covery of Stalactic Cares in, Mr Morton, 576, Tamanian Tamana Sea, 572 Empediam, Mrs. L. A. Meredith, 517, Dis-covery of Stalactic Cares in, Mr Morton, 576, Tamanian to Tamania in the Years 177-73, 429 Tolyon (Dr. C.), Elementary Geometry of Counce, 517 Taylor (Dr. C.), Elementary Geometry of Counce, 517 Taylor (Dr. H. Coupland), the "Leat," or 'Hot Wind of 1970 turb. 'H. Coupland), the "Leste, various turb. 'H. Coupland), the "Leste, various turb. 'H. Coupland), the "Leste, various turb. 'H. Coupland (1970), the coupland turb. 'Leste (1970), the coupland turb. 'L

Telegraph Company, Pacific Postal, Opening of New Telegraph Office in San Francisco, 231
Telegraphy, W. E. Weber, C. Runge, 272
Telephone, Extraordinary, Accident at Paris, 113
Telephone, Extraordinary, Accident at Paris, 113
Telephone, Extraordinary, Accident at Paris, 113
Telephone Service, the Faris, 361 W H I Freece, P. R. S., 50
Telephone, Extraordinary, Accident at Paris, 113
Telephone Service, the Faris, 362
W. Williams, 342
Telescopic Work for Stalight Exempting, W. F. Denning, 467
Temperature in Surope, Normal, M. Janasster, 347
Temperature in Surope, Normal, M. Janasster, 367
Temperature in Marope, Normal, M. Janasster, 367
Temperature, Underground, Hanny Becquerel, 612
Templecon 43 Evrahoms, 150 Loundstation of, Rev Hildern Friend, 273 Tempel-Swift's Comet, Discovery of, 551
Teneriffe, the Language of, Marquis of Bute, 511
Tensions, the Law of, H. G. Williams, 591 Terrestrial Magnetism and Radiant Sunlight, Connection between, Prof F H Bigelow, 453

Texas, Artificial Production of Ruin in, 436, 473, Prof George E Curtis, 594 Thermo-Electric Positions of Cobalt and Bismuth, Prof Knott. 311 Thermometers, the Testing of, at Berlin, 155 I hiele (Dr.), New Method of Preparing Azoimide, 601 Thompson (Di Ashburton), on Quarantine in Australasia, Theory and Practice, 366 Theory and Practice, 306
Thompson (I C), Copepoda as an Article of Food, 294
Thompson (Prof. Silvanus Phillips). Proposed Fellow of the
Royal Society, 16, an Optical Illusion, 187, on the Measurement of Lenses and on a New Polarizer, 455 ment of Lenses and on a New Polarizer, 455
Thomson (G M), cn Bees in New Zealand, 19
Thomson's (Joseph) Explorations in Youth Africa, 598
Thomson (Prof J J, F R; 5) on Vacuum Tubes, 93, 94,
Discharge without Electrodes through Gases, 187 Thomson (Frincipal), Olive Giowing in Australia, 501
Thomson (Surgeon Major), Leproy Bacillus cultivated in Serum by, 161
Thomson (Sir William, P R S), on Some Test Cases for the
Maxwell Holtzmann Doctrine regarding Distribution of Mayer remarks of the Corresponding Member of Royal Thorne (Dr Schorn), elected Corresponding Member of Royal Thornes (Dr Schornes), 18 p. 11 p. 18 p. Thursfield (Dr.), on Diphtheria, 369
Thurston (Edgai), Report on the Madras Central Museum, 629
Thurston (Edgai), Report on the Madras Laboration 426 Thurston Ledgal, Report on the Madras Central Museum, 629
Theet, Discovery of an Ancent Rosma Helmet in, 476
Thiet, the Vegetation of, 550
Thiet, the Vegetation of, 550
Timber Tests, on Government, B E Fermor, 471
Timber Tests, on Government, B D Fermor, 471
Timber Tests, on Government, B O Fermor, 471
Timber Company, 144
Timber Company, 144
Timber Company, 144
Timber Company, 144
Timber Company, 145
Ti The (G.), Action of Water on Base Sails of Copper, 36 Transed (Thomas Herry), Proposed Fellow of the Koyal Society, 16 Transed (Thomas Herry), Proposed Fellow of the Koyal Society, 16 Todhuster (I, F. R. S.), Plane Trigonometry for the U-e of Colleges and Schools, 342 Tokyo Botannesi Maganne, 236 greature, 353 Tokyo Diversity, College of Agriculture, 353 Tokyo University College of Agriculture, 353 Tokyo University College of Agriculture, 353 Tokyo University College of Agriculture, 357 Tomdon, (M.), Atmosphere Conductions of Greenwich with regard to University Hour (P. Colleges of Personal Colleges Tokin, W. A. Eddy, 512 Toronado, the Region Film, 18, Eddy, 512 Toronado, Large Dunten Hand, 113 Colleges of Marchael (P.), Protection of Strychmic and Snake Ponco, Dr. Mueller, 102 Transison of Power, Beletric J. J. Murphy, 590 Transison of Murphy, 184 Seption of Epolobum occurring North of Mexico, 1965 Missouri Botanleal Gardens, 588

- Traeste and Pola Harbours, the Mareograph in, Lieutenant Gratzl, 600
- Gratzi, 500
 Trigonometry, Plane, for the Use of Schools, I. Todhunter, F.R. S., 342
 Trimen (Dr.), Kinds of Cacao in Cultivation in Ceylon, 185
 Trimen (Mr. R.), Rearrangement of South African Museum
 Collection of Lepudopters by, 207

Tripe (Dr.), on Diphtheria, 369
Troilite, Meteoritic Crystallized Monosulphule of Iron, Dr. Richard Lorenz, 137

Trotter Curve Ranger, 45
Trotter Curve Ranger, 45
Trottes art (Dr. E. L.), on Microbes, 173
Trouton (F. T.), on the Propagation of Magnetization in Iron, Trouvelot (M), Luminous Outburst observed on the Sun, 234 I towbridge (John), Dampening of Electrical Oscillations in Iron Wires, 463

Truffle from Damas (Damascus ?), "Kammć," a New Species of,

A. Chatin, 512

Tubercle Baulli, Dr. Metschnikoff and Dr. Roux, 397

Tuberculosis, the Bacilli of, 12 Railway Carriages, Herr Praus-

Tuberculous, its fluction, its fluctions and coon, 393, or Tuberculous in all its Relations, Prof Burdon Sanderson, 393, Dr Bang, 395, Prof. Arlenng, 396, Prof M'Faydean, 16, Prof. Ilsaulton, 397, Prof. Nocard, 397, 1r I line, 317, Dr Barlow, 397, Prof Perronetto, 397
Tuberram (Dr Alfred), Bibliography of the Chemical Influence

Tuckerman (Dr. Alfred), Bibliography of the Unemical immunion of Light, 200
Tuckwell (W), a Rare Phenomenon, 519
Tuckwell (W), a Rare Phenomenon, 519
Tuncata, the Classification of the, in Relation to Evolution, Prof. W. A. Hertiman, 130
Tunning-fork, the Testing of, 155
Turbellaria Accela, Die Organisation der, Dr. Ludwig von Graff,

Prof. E. Ray Lankester, F.R S . 465

Froi. E. Ray Lankester, F. K. S., 405
Tarkesten, Cotton Cultivation in Rassian, 163
Tutton (A. E.) · the New Gas, Calorofluorate of Phaspharus,
333; Further Researches upon the Hemett Fluaine, 622
Tyler (Thomas), University of London, 104
Tylor (Dr. E. B., F. R. S.), on Savage Religion, 511

Ule (Dr), Determination of Evaporating Power of a Climate,

Underground Temperatures, Henri Becquerel, 632 Unacerground icmperatures, H.nr. Becquereh, 93. Unit d States United States Bolancal Appointment in, 13.5. Unit d States Entomological Cosmission, 217, Prof. M. W. Hirringrou appointed Chief of the United States Weather Bureau, 260, Science and Domesus Comfort in, 354; United States. Copyright Act, 368. Three Alters bearing upon the Meteorology of, 540, U.S. Fish. Commission. Reports, 562, Marble Quarrying in, E. R. Mone, 576. United States, see also. America

Units and their Nomenclature, 454 Universities, the Proposed French Law on, 185 University College, Endowment by Mr George Holt of Chair

of Physiology at, 135 University of Edinburgh . Summer Graduation Ceremony, 323, Presentation of Cameron Prize to Dr. Ferrier, F. R. S., 351 University and Educational Intelligence, 21, 48, 91, 138, 105,

and Science Schools at, 111, and Agricultural Education,

183
University, the Proposed Albert, az Albert
University, Proposed Teaching, for London, 257
University in Slam, Proposed, 232
University in Slam, Proposed, 232
University in Slam, Proposed, 232
Unquhart [John W.], Eletert Light Fitting, a Hand-book for Working Electrical Engineers, 586

Vacuum Tubes, Prof J J. Thomson, F. R.S., on. 93, 94 Vambery (Prof), on British Civilization in Ana, 88 Vanaduum, Sulpho saits of, 19. T. E. Espin, 578 Variation and Natural Selection, Dr Alfred R. Wallace, 518

Varnash, Hankow, 163 Vatican Observatory, Publications of, 136

Vault of the Heavens, Apparent Flattening of the, Prof. Rev-

Vault of the research, mann, 67
Weeder (M A), Addiscal Light and Auroræ, 631
Vegetation of Fiber, 260
Vettch (H J), on Autumn Foliage, 628
Vettch (H J), on Autumn Foliage, 628 Ventilation, Importance of more Actively Enforcing, Dr. J. P. Williams Freeman, 487

Williams, Preenais, 487

Wendaliams, W. Key on, 509

Vernon Haccourt (1. F.), Achievements in Engineering, 147

Vernor Haccourt (1. F.), Destribution of Lunar Heat, 50c Hostopheron, 147

Very (Prant, H.), Destribution of Lunar Heat, 50c Hostopheron, 160c, 120c, 160c, 16

Vidal (Léon), Photography as an Auxiliary to Printing, 136 Vienna International Ornuhological Congress, 111 Vienna Natural History Museum, Mineral Department, Capture of a Supposed Gem Pluef, 598

Villami (Major R. de), on Screw Propellers, 510
Ville (Georges) a Series of Addition Compounds of Aldehydes with Hypophorous Acid, 282, Les Fingrais Chimiques, 517 Virchow (Prof. Rudolph) Testimonial Fund, the, 324, Cele-brition of the Seventieth Birthday of, 574, and his Country

men, 585 Virial Equation, Van der Waals's Treatment of Laplacc's Pres-sure in the Lord Rayleigh, F. R. S., 499, 597, Prof. P. G.

Tait. 546. 627

Tati, 546, 627
Virus, Les, par Dr. S. Arloing, 27
Virus-Cloud, Mr. G. V. Poorer and, 135
Volcanoes: the Eruption of Venuvus, June 7, Dr. II J. Johnson Laves, 160, Scopping of Lava Flow From Vesserius, 161, a stone I area, 160, Scopping of Lava Flow From Vesserius, 161, a stone I area, 160, Scopping of Lava Flow From Vesserius, 161, perments on Mcchamcal Action on Rocks of Gas at High Pressure in Rapid Motion, M. Paubrice, 240, a Recent Empiron of Strombolt Prof. A. Riccio, 280, the Eruption of Venuvus, 161, Johnston Lawa, 30, the State of Venuvus, Dr. Johnston-Lawa, 39, South Italian, Dr. Johnston-Lawa, 39, South Italian, Dr. Johnston-Lawa, 39, South Italian, 101. Johnston-Lawa, 39

W. - Mc, W. Larden, 923, 614, Tommy Atkins, Sen. 493 Waals's (Van dee), Treatment of Laplace's Pressure in the Virsal Fugation, Lord Rayleigh, F. K. 3, 499, 597, Fiof. P. G. Tait, 546, 634, W. Species of Russian Trap Spider, 359 Wagner (W. A.), New Species of Russian Trap Spider, 359 Walker (Alfed O.), the Use of Starting Colours and Noises,

Walker (C L.), Archæological Researches in South-West New

Mexico, 576
Walker (J J., F R S), some Notes on Ornithology and Entomology, 565
Wallace (Dr A R) Natural Selection and Tropical Nature.

Wa'lace (Dr. A. R.) Natural Selection and Tropical Nat 40. Variation and Natural Selection, 518 Ward (F. O.), a Souvenir of Faraday, 230 Ward (R. de C.), Climath. Httory of Lake Bonneville, 464 Warngton (R.), Natrification, 190

Washington Magnetic Observations, 91
Washington Medical Library, Catalogue of the, Dr. A. T.

Washington Medical Library, Citalogue of the, Dr. A. T. Mylers, 036 Mylers, 162 Mylers, Essamanaion of, for Sanitary and Technical Perpose, Henry Leffmenn, M. D., and William Beam, 163 Mylers, Essamanaion of, for Sanitary and Technical Henry Leffmenn, M. D., and William Beam, 163 Mylers, 163 M

Index

Water, Production of Local Ansesthesia by Subcutaneous In-Water, on the Variation of the Density of, at Different Temperatures, Prof. Mendeleeff, 334
Water-Birds that live in the Woods, G B Sennett, 529

Watkin (Sir E). Proposal to place Electric Light on Snowdon.

waters (Nr E.); ropposa to piace Lecture Legis on showous, Waters (Arnold T.), the Protective Device of an Annelid, 507 Watson (Inlin), Redevelopment of Lost Limbs in Insects, 163 Watson (Willim Barnett), Death and Obtuary Notice of, 574 Wattles and Wattle-harks, J. H. Manden, 577 Wattles and Wattle-harks, J. H. Manden, 577 (wead (C. K.), on the Intensity of Sound, in the Energy used

Wead (C. K.), on the intensity of Schuller, in the contral, and by Organ puper, 310
Weather Changes, a Cycle in, 225
Weather Charts, European, Captain C. H. Seemann on, 41,
Daily International, 62
Weather Cycles, Prof. J. P. O'Reilly, 541
Weather Cycles and Serere Winters, 501

Weather Cycles and Serere Winters, 501

Weather and Disease, Herr Magelssen, 113 Weather Prospects in North-West India, 303

Weather Record of the Fourteenth Century, William Mede.

538
Weather Service, How can it best promote Agriculture, M. W. Harrington, 165 Weber (Wilhelm Eduard), Death of, 206, Obituary Notice of,

229, C Runge, 272
Webster's Dictionary of the English Language, 102
Weeren (Dr.), Course of Insolubility of Pure Metals in Acids.

259 Weights and Measures Proposed International System of, C. J Hanssen, 41, Old Standards of, 280, the Discovery of the Standards of 1758, 395, International Committee of, 475 Weismannium, a Difficulty in, Prof. Marcin Hartog, 613 Weiss (Dr.), Death of, 388

Werner (E. A.), Action of Acetic Anhydride on Substituted
Thiocarbamides and an Improved Method of preparing Aro
matic Mustard Oils, 118

West (Prof G M), the Growth of the Face, 325 West Indies, Botanical Enterprise in, 110

West Indies, Botanneal Bieterpine in, 1 to
Westergard (Frof Hardl), Alcobolium, 484
Westermarck (Edward), the History of Human Marriage, Prof
Westermarck (Edward), the History of Human Marriage, Prof
Westerfact (Di. Negle, a Microscopic study of the Inferior Oolite
of the Cotteswed Hills, 95
Westerfact (D), Force and Determinism, 325
Gonda, 94
Wistriag Ring, the Flying to Pieces of 4, Chis. A CarisWilson, 31, C. Chee, 82
White (A. H.), Unusual Forst Phenomenon, 519
White (W. H.), so the Shipbalding Maternal at the Naval
White (M. H.), so the Shipbalding Maternal at the Naval

White (W. 11), on the Shipbaiding Naterna at the Naturbillot, 572 Whitworth Scholarships and Exhibitions, 392 Whitworth Scholarships and Exhibitions, 392 Whitworth Scholarships and Exhibitions, 392 Whiten (M.), Death of, 500 Wilkinson (Chas Smith), Death and Obsturey Notice of, 574 Wilkins (Dr. Naturbal), Physiological Effects of Alcohol, 351 William (M.), the Experience In Improach of Drugola, 301 William (M.), the Later Larral Development of Amphonats, 472 (M.)

21, 202 Williams (A Stanley), Newly discovered Markings on Saturn,

Williams (George Huntingdon), Crystallography for Students of Chemistry, Physics, and Mineralogy, Prof John W Judd,

"of Chemistry, Physics, and Dunissens," F.R.S., 193 Williams (H. G.), the Law of Tentions, 591 Williams (H. G.), Newtonite and Rectorite, New Minerals of Williams (J. W.), Newtonite and Rectorite, New Minerals of Williams (J. W.), Newtonite and Rectorite, New Minerals Williams (J. W.), the Telescope, an Introduction to the budy of the Hexerost, 124 Williams (W. Mattoel). See the Minerals of Monators, 194 Williams (W. M. E.) on the Alastrophysion of Heat in the Solar Atmosphere, 453; a Rare Phenomenon, 494 Atmosphere, 453; a Rare Phenomenon, 494

Atmosphere, 453; a Rare Phenomenon, 494 Winchell (Prof. Alexander), Obstuary Notice of, 601 Wind, Barometer at Ben Nevis, Observatory in Relation to,

Dr. Buchan, 167 Wind, is Influenza Spread by the, H. H. Hildebrandsson, 165

Winds of Ben Nevis, the. R. T. Omond and A. Rankin, 191 Wine, the Yeast of, A. Rommier, 512 Winter (John L.), Technical Education for Farmers, Farriers,

and Engine Drivers, 320
Winters in Essex County, Massachusetts, Old-time, Mr. Perley

on, 353 Wishaw (Bernhard) and E B Sargant, a Guide-book to Books,

196
Witkowski (A. W.) the Expansion and Compressibility of
Atmospheric Air, 312, an Electrical Thermometer for Low

Temperatures, 312
Wisslocks (Dr. H. von), on the Handicrafts of the Hungarian

Wishook (Dr. 1 von), on the rianderates of the Hungaria Gypsies, 630 Wood (R. W.), Consumption of Gas Jets under Pressure, 189 Woelkof (Dr.), Snow-slips in the Kazbek Glaciers, 600 Wolf's Comet, Re-discovery of (1884 III.), 69

Wolf's Periodic Comet (6 1891), 209, 478 Wolter (A). Use of a Monobromnaphtalin in Study of Ultra

Violet Rays of Spectrum, 207

Wood. Protection against Decay, Chemical Methods of, () Chanute, 476
Wood (W F), Lightning Spectra, 504
Woodhead (Dr), on the Milk and Meat of Tuberculous Animals,

396 Woodhead (Sims, M D), Bacteria and their Products, 246 Woodwork in Public Elementary Schools, Instruction in, the

Woodwork in Tubice Elementary Schools, Instruction in, the City and Guilds of I ondion Institute and, 327 Woolls (Rev Dr W.), the Classification of Eucalypts, 41 World's Fast at Cheago, 629 Wright (G Frederick), the Ice Age in North America, Prof. T. G. Bonney, F. R. S., 537 Wright (1976), the Ice Age in North America, 480

Writing, Hygienic Advantages of Erect as compared with Slanting, Drs Von Reuss and Lorenz, 325 Wroughton (Mr.), Ant imitating Bag, 262

\ ale University, Observatory of, Dr Elkin, 283 Varkand, Coleoptera of, 318 Yeast of Wine, the, A. Rommier, 512

Vellow-Fever, Preventive Inoculations of, 392
Young (C. A.), Lessons in Astronomy, 342
Young (Dr. S.), Dibenzyl-Ketone, 287, Vapour-pressures of Mercury, 287

/ichen (Dr. Th.), Physiological Psychology, 145 Zimbabye Ruins, Mr. Theodore Beut's Investigation of, 451 Zodiacal Counter Glow, Observations of the, E. E. Barnard,

/odiacal Light as related to Aurora, O T Sherman, 310, M, A Vecder, 631 Zoology, Additions to the Zoological Gardens, 19, 42, 69, 89, JONES THE 138, 186, 208, 234, 259, 283, 304, 327, 354, 391, 116, 438, 453, 478, 502, 551, 577, 601, 631, the insections in 103, 168, the Scorpions at the 163, R. I. Pocock, 198, Opening of Stall for Sale of Zoological Photographs, nome in 1931 to 1931 t Upper Assem, 598



A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

"To the solid ground
Of Nature trusts the mind which builds for age."—WORDSWORTH

THURSDAY, MAY 7, 1891.

FOSSIL INSECTS

The Fossil Insects of North America, with Notes on some European Species. By Samuel H Scudder 2 Vols 4to, Illustrated. (New York Macmillan and Co. 1800)

"HE name of Mr S H Scudder is familiar to students of every branch of zoology through his invaluable "Nomenclator Zoologicus" Though that work alone would be sufficient to earn the gratitude of zoologists, yet the author's claims to especial distinction really rest on the results of his investigations into the structure and distribution of fossil insects, and more particularly those of North America.

The magnificent work before us, containing considerably more than a thousand pages of letterpress, and illustrated by no less than sixty-two beautifully-executed plates, as well as by numerous figures in the text, contains, in a collective form, practically the whole of the author's contributions to the history of North American fossil insects, together with much important information relating to those of Europe In reality, however, it treats of more than is revealed by its title, since the author includes under the head of insects not only the animals usually thus designated (which he distinguishes as Hexapods), but likewise the Myriopods and Arachnids Since the issue of the work is limited to 100 copies (each separately numbered), it is probable that it will soon acquire an adventitious value above that which it possesses from its intrinsic ments. Apart from the author's admirable account of fossil insects (in the larger sense of the term) contributed to Prof. von Zittel's "Palæontologie," the work is the only one giving an exhaustive history of the subject, and is therefore invaluable to all interested in this branch of study. And the excellent manner in which the volumes are turned out demands a meed of praise alike to author, artists, and printers. Indeed, the only serious fault in the book is that in the first volume no explanation of the plates is given otherwise than in the satisfactory condition, Mr. Scudder, at the commencetext, at the close of the articles they severally illustrate.

The first of the two volumes treats exclusively of the pre-Tertiary insects, and consists of a reprint of upwards of twenty articles and essays published in various serials. dating from December 1866 to September 1890 The second volume, which is a replica of the one recently issued by the U.S. Geological Survey of the Territories, formerly under the charge of the late Dr. F. W Hayden. contains practically the whole of what has been written concerning the Tertiary fossil insects of North America. in which field the author, with one small exception, is the sole worker

In the first volume, as we are informed in the introduction, the whole series of essays shows the manner in which the author's views have been gradually modified in certain respects with increasing knowledge, and we think he has exercised a very wise discretion in allowing the articles to stand as they were written, and thus permitting the gradual evolution of his later views to be traced

The earliest known true insect is Palaoblattina of the lower part of the Upper Silurian of France, regarded by its describer as a cockroach, although considered by our author as probably one of the Neuropteroid Palæodictyoptera (p 286); but with this exception the insects from the Upper Devonian of the United States claim the earliest position. It is, however, only (as the author tells us elsewhere) when we reach the coal-measures that we find insect-faunas of any considerable extent, such as those of France and Illinois The Permian, if, with the author, we refer the coal of Saarbruck to the Carboniferous, is, however, poor in insects; and the Trias, with the exception of that of parts of Colorado, almost barren. The later Secondary beds of America are likewise very barren of insect-remains, so that we have to turn to Europe to gain any definite knowledge of the fauna of that date In the Tertiaries abundant insect-faunas occur in several river and lake-basins of both hemispheres; two of the most celebrated being the Florissant basin of Colorado, and that of Eningen on the Rhine.

The wings of the Palæozoic insects being those parts of the body which are most commonly preserved in a ment of his studies, devoted particular attention to this subject, and the first volume commences with an inquiry into the relationship of the Neuropterold insects of the North American Carboniferous to the existing Neuroptera, as exemplified by the structure of their wings. It would be out of place here to allude to the variations in the structure of the veins of the wings presented by different groups of insects, and their derivation from a common plan of structure; and we may accordingly proceed to notice the most interesting chapter in the whole volume. This is the essay on Palæodictyoptera, commencing on p 283. Here we have a detailed account of the reasons which induced the author to separate the whole of the Palæozoic insects from the existing orders under the name of Palæodictyoptera-a term first proposed by Goldenberg in lieu of Dohrn's preoccupied Dictyoptera, which had been suggested for an order typified by the Permian Eugereon This order is defined more by the generalized characters of its various members, and the lack of those special characteristics which are the property of existing orders, than by any definite peculiarities of its own One of its most important features is, however, that the two pairs of wings are always closely similar to one another, being equally membranous, and with the six principal veins always developed. With the exception of a few cockroach-like insects found in the American Trias, the Palacodictyoptera not only includes all the insects of the Palæozoic, but is restricted to that period, and is, therefore, extremely convenient to the geologist. The order is divided into various sections, which are severally regarded as the ancestors of the existing orders whose names they bear. Thus, the Palæozoic cockroaches constitute the Orthopteroid Palæodictyoptera while we have a Neuropteroid section represented by Platephemera, Mianua, &c : and an Hemipteroid one by the above-mentioned Eugereon. The presence in wood of Carboniferous age of borings similar to those made by modern Coleoptera, further suggests the existence of a Coleopteroid section of the order The author (p. 320) considers that such Coleopteroids "at first showed no greater distinction between the front and hind wings than existed in other Palmodictyoptera, but afterwards those races were preserved in which the thickening of the membrane of the upper wings the better protected the insects in their burrows for the marriage flight in open air."

The author gives a still fuller account of the reasons for adopting the order Palledottyoptera, in the essay on "Winged Insects from a Palacontological Point of View" (p. 317), from which the preceding extract is taken. Great stress is there laid on the fact that the differentiation of wing-structure characteristic of modern insects did not exist in those of Palacontic cutients; all of them having a common type of neuration barely admitting of division into families. The differences in the organs of the mouth, as exemplified by the biting Prognoslatina (a Palacontic occhorach) and the suctorial Eugeron, are considered merely as physiological adaptations of no morphological value (pp. 246, 285).

The facts and arguments detailed by the author leave, then, no doubt as to the close affinities and undifferentiated characters of all the Paleozolc insects; and also that the group Paleodictyoptera includes the ancestors of a considerable number of the existing orders of insects.

Since, however, all the latter are clearly divergent branches from one or more common stocks, and are in no sense ancestral to one another, the suggestion arises whether it might not be advisable to group all the existing orders together-say, under the name of the Neodictyopterine "series"; and to rank the Palæodictyoptera as a series" of equal value, in which the various members were not sufficiently differentiated from one another to constitute "orders" It is a very significant fact that, while the Palæozoic insects show ancestral forms of those recent orders grouped together by Packard as the Heterometabola, they include no ancestral types of the more specialized orders-Lepidoptera, Hymenoptera, and Diptera-constituting the Metabola We have, therefore. proof that these specialized types are of later date; and it thus appears that palæontological evidence is in favour of Packard's classification 1 Of the existing orders of insects it appears, indeed, that while the Neuroptera, Orthopters, and Coleopters are more or less fully represented in the Trias, it is not till the Lias that we meet with Hemiptera (Rhynchota), although Eugereon may be taken as sufficient evidence that a Triassic member of that order must have existed None of the Metabola are known before the Lias, the Diptera and Hymenoptera dating from that epoch, while the Lepidoptera are unknown till the Middle Jurassic

Though space does not permit of much further reference to the true insects of the pre-Tertiary epochs, we cannot pass over the interesting essay (p 323) on the oldest known insect larva. These larvas, which appear to be very abundant in the Trias of the Connecticut River. are known as Mormolucoides (Palebhemira), and there has been much discussion as to whether they indicate Coleopteroid or Neuropteroid insects Mr Scudder's mode of treating this difficult question is a model of palæontological induction After carefully reviewing all the evidence, he concludes that the fossils come nearer to the larva of the Neuropterous families Perlide, Ephemeride, and Stalide, and that the relationship is nearest to the latter family, which belongs to the true Neuroptera Another exceedingly interesting article (p. 433) refers to the cockroaches of the Fairplay beds. Colorado. Several of the species from these beds belong to the Palæodictyoptera, showing the complete interdependence of two of the veins of the fore-wing characteristic of the Palæozoic types Others, however, are true Orthopteroid cockroaches, and we thus seem to have presented to our view the very period when the Palæodictyoptera were passing into the Orthoptera. From the mingled Palseozoic and Mesozoic facies presented by their insect fauna, the author is disposed to refer the Fairplay beds to the Trias, although, as is so frequently the case, the plantevidence does not accord with that presented by the

Passing to the Palizonic Myriopods, we notice that while all the forms described in the earlier essays are clearly referable to extinct ordinal groups, the progress of discovery has recently shown (p. 393) that side by side with these lost types there existed in the Coal measures of Illinois Centipedes closely allied to existing forms, and

Many ambornies, attaching more importance to the nature of the metamorphosis, transfer the Coleopoura to the higher group (Melounstabela), is which some also include the true Neuroptera, placing the Pseud neuropter with the Orthoptera.

belonging to the same ordinal group (Chilopoda). The essays respectively commencing on pp. 195 and 247 of the first volume give the full history of the specimens on which the author founded the orders Protosyngnatha and Archipolypoda. The former group is represented only by a single specimen from the Carboniferous of Illinois. described as Palaocampa; this curious creature being of small size, and in its short body, with pencils of bristles on the back, presenting a superficial resemblance to the well-known larva of the tiger moth. Of more interest are the Archipolypoda, confined in America to the Carboniferous and Permian, although represented in the "Old Red" of Scotland A restoration in Plate vii. A, of one of the largest of these creatures (Acantherpestes) gives an excellent idea of their extraordinary appearance, the animal being represented as emerging from the water and ascending the stem of a Lepidodendron. The figured species attained a length of about one foot : its amphibious habits being inferred from the presence of lateral apertures presumed to be branchial The Archipolypoda agree with the Diplopoda, or Millepedes (and thereby differ from the Chilopoda), in having two ventral plates, each carrying a pair of limbs, to every dorsal plate, but differ in that each dorsal plate occupies at most only two-thirds, instead of nearly the whole of the circumference of the body. The larger species, like the figured one, were further distinguished by carrying rows of long spines on the dorsal plates The smaller forms originally discovered by Sir I W. Dawson in the Sigillarian stems of Nova Scotia, which were doubtless of purely terrestrial habits, and have been described as Xylobius and Archsulus, appear to indicate a distinct group of this order approximating to the modern Millepedes

As an instance of the danger of drawing inferences in palæontology from negative evidence, we may quote a sentence from p 196 of the first volume, where the author states that "The Diplopoda are universally considered the lower of the two in their organization, and it is therefore not surprising to find that no Chilopoda have been found in rocks older than the Tertiary series, while Myriopods with two pairs of legs corresponding to each dorsal plate range back through the entire series of rocks to the Coal-measures" This inference is, of course, completely traversed by the above-mentioned discovery of Carboniferous Chilopoda; and it may be suggested whether the presumed coalescence of two dorsal segments in the Diplopeds and Archipolypeda is not a character in advance of the Chilopoda.

The only essay devoted to Arachards in the first volume is the one commencing on p. 419, which was originally published for the first time in September 1890. This easy treats of the Palescole order Anthracomatti, and of that division of the Pedipalpi known as the Phrynides; the Scorpions being reserved for a future occasion. The Arachards differ from both the insects and Mynopods in being represented by an existing order (Scorpions) as far back as the Shurian Indeed, the only extinct order of the class is the Anthracomatti, which is confined to the Carboniferous, and is regarded a having some points of connection with the Aleitarhosomists, as represented by the Phalangida ("Harvestimen"), and others with the Pediapalpi, the Teationship

being on the whole nearer to the latter. They are characterized by their somewhat depressed bodies, in which the abdomen is distinct from the cephalothorax, and consists of a single mass composed of from four to nine distinct joints; while the palpi are short, and do not terminate in pincers or claws. With the possible exception of the Scorpions, these appear to have been the most abundant of the Carboniferous Arachnids, and were represented by a number of genera; those described in the essay before us being arranged in two families and six genera. In the Phrynidean section of the Pedipalpi, containing the Spider-Scorpions, Mr Scudder describes a new Carboniferous genus, Graophonus, besides giving further characters of a previously-described species of Ceralinura. whose nearest living ally is Thelythonus, of the tropical regions of Asia, America, and Australia

Passing to the second volume, on the Tertiary insects, of which only a very brief notice can be given, we may touch upon a few points mentioned by the author in the introduction One of the most noteworthy circumstances to which he refers is the extraordinary profusion in which insect remains have been preserved in some of the Tertiary lake-basins of North America, this being especially the case with the Florissant basin of Colorado, belonging to the Oligocene epoch Not less remarkable is the fact that in "liardly a single instance has the same species been found at two distinct localities", and this not only when the localities are separated by hundreds of miles, but even when they are comparatively near. The author considers that this peculiarity may be explained by the absence of exact synchronism between any of the insectiferous beds, and he is thus led to infer that insects will probably afford very valuable aid in determining geological horizons, the modification of species having progressed much more rapidly than is the case with plants

Another point to which attention is directed relates to the extraordinary number of forms known only by a single specimen, the author stating that, it beds whence thousands of insects have been obtained, every third or fourth specimen will prove to be a new form. The interest of these investigations is enhanced by the discovery that a considerable proportion of the Fertiary invests must be referred to extinct genera, the author considering that a large number of the species he has placed in existing genera will eventually have to be removed to new ones. We trust, however, that Mr Scudder will not burden the science with more new terms than are absolutely essential; more especially since, if he favours us with a new edition of his "Nomenclator," he will have the additional labour of recording them as second time.

Following the introduction there is a chapter desorded to the American localities where fossil Tertairy insects are most abundantly found. In addition to the Florissant basin of Colordo, there are deposits of approximately the same age on the White River in Colorado and Utah, as well as on the Green River in Myoming. Less productive spots include a town in Myoming, rejoicing in the appropriate name of "Fossil," as well as various places in British Columbia, Ontario, and Pennsylvania. There are also a certain aumber of insects—mostly Colorpera—from Pleistocene or recent bone-caves and other superficial deposits.

By far the greater bulk of the enormus collection with which the author has had to deal was obtained from the Florisant basin; and it is to these alone that from the Florisant basin; and it is to these alone that the present volume (large as it, however, so vast that in the present volume (large as it, however, so vast that in possible to deal only with the Arachnids, Myriopods, and the Neuropiers, Hemiptera, and Orthoptera among the true insects. Some introductory remarks are, however, great as to the relative proportions in which the Lepidoptera, Hymenoptera, Diptera, and Coleoptera, are represented in these beds.

The total number of specimens of insects obtained from Florissant during the labours of a single summer is estimated to be more than double that obtained during thirty years at the celebrated European locality, (Fningen A remarkable difference occurs between the relative number of species of the different orders of insects found at the two places. Thus, while at (Lningen the Diptera are less than 7 and the Hymenoptera less than 14 per cent of the whole; at Florissant they reach respectively 30 and 40 per cent On the other hand, while the (Eningen Coleoptera form nearly half of the whole number, at Florissant they fall to 13 per cent The great percentage of rlymenoptera is due to the prodigious number of ants; in which respect, as also in the small proportion of beetles, the fauna agrees better with that of Radaboj, in Croatia, to which it likewise approximates more closely in age. It would take too much space to enter into the details of the proportions in which the various families of the different orders are represented in these beds, but it appears that, with the exception of the Lepidoptera, nearly every prevalent family may be demonstrated to have been in existence at that epoch Among the beetles, about three-fifths belong to the normal series, and the remaining two-fifths to the weevils; water-beetles being unexpectedly scarce | Lepidoptera are rare, only eight species of butterflies, all referable to different and extinct genera, and about the same number of moths being at present known it is of especial interest to note that, while seven of the eight butterfies belong to the Nymphalida, no less than two of these are referable to the sub-family Libytheina, the members of which, although found in every quarter of the globe, are fewer in number than many other groups, consisting only of ten species, referable to the single genus Libythea It is, therefore, a legitimate inference that the Libythema have been on the wane since the Oligocene or some later Tertiary epoch Some writers, it may be mentioned, regard Libythen as the representative of a family rather than a sub-family

In taking leave of the author, we congratulate hum on the patience and perseverance which have carried him thus far through a tax's of unusual magnitude and difficulty, and hope ere long to have the pleasure of welcoming its completion. With the widely-extitered literature of patienticles yet even increasing, the importance and value of monographs like the present, where the whole subject is collectively treated by a master-hand, cannot be too highly estimated.

² (Eningen is situated on the right bank of the Rhine, between Shaffhaus and to the Bades, and not, as the au hor states on p st, Bayers.

NO. 1123, VOL. 44

STATISTICS OF POPULATION AND DISEASE.

Studies in Statistics. By George Blundell Longstaff.

"S TUDIES" as a title appropriate to these somewhat detached investigations concerning at least three different classes of subject. The first few chapters, relating to vital statistics, are described by the author as "of an introductory and elementary character"; though the discussion which is contained in one of them, on the fluctuation of death-does not appear to us so very radimentary of death, does not appear to us so very radimentary.

or teating, does not appear to a secretary with the "growth of population" when the bob "missing increase" or fining paration. English and wales alone add 1000 a day of the bob will up the gape caused by death, a fresh regiment at foll was terriging daily marches to the front. "To what quarters are they marching? The answer may over a consideration of intra-migration, as Mr. Longstaff terms the migration between the several divisions of the same kingdom. The incurry brings into vision the relatively slow increase of rural as compared with urban durities," accorning to the United Kingdom.

These and other facts, extracted from records accessible to all, are not absolutely new to the student of Statistics Yet they excite gratuited, almost as much as if they were wholly due to the author, enhanced as they are by the wealth of his inferences and the luxury of his illustrations.

The statistics of the growth of America are less familiar to the English reader By a carefacil By a partial analysis of the American census, Mr. Longstaff estimates that nearly one-third of the whole populsion (almost 35 per cen!) is "foreign"; considering as foreign not only those born of foreign parents (whether in American or elsewhere), but also half of those who, though native-born, have one foreign parents (whether in American or elsewhere), but also half of those who, though native-born, have one foreign parents (whether yellow) and political danger, particularly in the case of the rapidly growing coloured population in In more than sense, says the author, a black cloud may be said to bang over the future of the Republic.

Canada is not equally threatened by the dangers anising from a mused population. Yet, even in Canada, the fact that the persons of French race form about a third part of the population, and increase more rapidly than any other known people, "cannot but be a source of anisety and possible trouble in the future." The solidity of our Australian colonies is more perfectly satisfactory.

Surveying the British Empire, the writer colbibits the growth of the colonies relatively to the mother country during the last half-century. Whereas the ratio between the populations of the colonies and the United Kingdom was 7, 100 in 1841, it had become 21 100 in 1881. Entertaining the dead of an Imperial Federation, our statistical thus estimates the balance of power in the imagined Federal Parliament. If every 100,000 of white population are entitled to one representative, then of per cent of the Imperial Parliament would be Engish; the proportions for Scotland and Ireland would be 3 and 13 per cent. respectively.

But the political interest of these estimates must not detain us from what is perhaps the most severely scientific part of the work before us-namely, the investigation of the causes of disease. This medical portion of the volume may, as the author fears, "prove too technical for many readers"; and, perhaps we should add, critics. The student of such statistics must bring much knowledge in order to carry away much. The need of this requisite may be illustrated by one of Mr. Longstaff's examples Certain of the curves which he traces show a remarkable correspondence between the outbursts of diphtheria and a group of other diseases, amongst which are croup and cynanche maligna. And yet between the two latter diseases and diphtheria the correspondence at some dates is not so close as the suggested theory desiderates Diphtheria in 1850 rose enormously, while the other diseases did not rise simultaneously, or even feil But, as we understand the matter, the theory is saved by the surmise that many cases previously ascribed to croup and cynanche maligna, were put down to diphtheria in 1859 and afterwards, when the stir created by letters in the newspapers had excited the attention of observers to the "new disease" This is one of those explanations of figures which an outsider would probably not even have thought of, and the importance of which he is little qualified to estimate

The "ætiology" of the subject must be left to the expert. The general reader, if he cannot penetrate to the laws of causation, may at least admire the uniformity of results which the author's diagrams exhibit. The nature of some of his observations, and the labour and care which they required, are indicated in the following quotation -

"The object of my investigation was . [principally] to see whether any, and if so what, relations subsist between diseases believed to be distinct. . . I accordingly traced eighty-nine curves representing the death-rates per million in England and Wales from as many 'alleged causes.' . . By a simple application of the law of combinations, it will be found that to compare all these eighty-nine curves two and two together, would involve 3916 operations Of these I have as yet actually made only 1225"

This comparison of curves representing the fluctuation of death-rates for different diseases forms some of the most beautiful pieces of statistics which we have ever We may allude in particular to the comparison of erysipelas, scarlating, rheumatism of the heart, and certain other diseases with each other and the variations in the rainfall (Plate xix.). The death-rates are shown to be parallel to each other, not only for different times, but also, in the case of three of the diseases, for different places in all the eleven registration counties of England and Wales. The splendid diagram which exhibits this manifold comparison (Plate xxi.) affords, as the author points out, a good illustration of the value of large numbers in statistical inquiries.

"The curves for England and Wales exhibit smaller fluctuations than those for sections of the country, and the correspondences between them [between the rise and fall of death-rates for three specified diseases] are in nearly all cases much closer."

Among investigations of which the interest appeals to the mere statistician as distinguished from the medical expert, we may mention the calculation of the frequency with which coincidences between the deaths of both husband and wife from phthisis "might be expected to occur as a pure matter of chance, on the hypothesis that

NO. 1123, VOL. 44

phthisis is not a communicable disease." By a beautiful application of the calculus of probabilities, the following conclusion is reached:--

"It is plain, therefore, that, to show any substantial argument for the existence of infection, it would require a much larger collection of cases than has yet been published."

Another inquiry which the general reader will follow with peculiar interest relates to hydrophobia. The statistics suggest laws very different from popular beliefs The paucity of the observations, however, necessitates caution; which Mr Longstaff does not fail to inculcate It is not his least merit that he instils what may be called the logic of statistics by occasional precept, as well as by repeated examples

OUR BOOK SHELF.

The Best Books . A Contribution towards Systematic Bibliography By William Swan Sonnenschein Second Edition (London: Swan Sonnenschein and Co., 1891.)

THE idea of this "contribution towards systematic bibliography" is excellent, and has been excellently course.

When interest in a subject has been excited, the first question of the student, of course, is, Who are the best and most recent authorities on the matter? The question is by no means always easily answered, for as yet there are few good subject-indexes, and the most valuable of The present them are not within the reach of everyone volume may almost be said, for ordinary practical purhas not attempted anything so ambitious as a philosophic classification of the sciences He has worked out his scheme on what he properly calls "a common-sense plan," grouping books first into large classes, then breaking them up into sections, sub-sections, and paragraphs-"with the result of obtaining all the literature of one subject in one list, and that of outlying subjects close at band." He begins with theology, next takes mythology and folk-lore, then philosophy, society (including many different branches), geography, history, archaeology, and so on, until all important departments of knowledge have been included. No one who has occasion to use the book will have the slightest difficulty in understanding the principle, or in finding the particular subdivision presenting the facts of which he is in search. edition contains the titles of twice as many books as the first edition (50,000 as against 25,000), and, so far as we have been able to examine them, they seem to have been admirably selected Here we have to do only with the scientific part of the work, and, considering how vast is the material from which Mr Sonnenschein had to choose his lists of scientific treatises, he may be con-gratulated on the manner in which his task has been accomplished. For the most part, he refers only to books that are in print, and easily obtainable The very best books he has "asterisked," and in every case he gives the dates of the first and last editions, with the price, size, and publisher's name. Two separate indexes—one, a list of authors, with the titles of their works; the other, a list of subjects-add greatly to the value of the compilation.

The Fairyland Tales of Science. By the Rev. J. G. McPherson. Second Edition. (London: Simpkin, Marshall, and Co. 1801.)

THIS volume consists of a number of papers which appeared originally in various periodicals. does not profess to embody in them the results of independent research. His object is to give to readers who may not have access to recent scientific authorities "an accurate and at the same time interesting account of the remarkable discoveries in science during the last decade."
This object he attains. His style is clear and straightforward, and, without being "sensational," he knows how to present facts and principles in a way that is likely to surfest attention and awaken curlosity. Among the subjects dealt with are the formation of dew, the colour of water, dust and fogs, lightning, sun-spots, after-glows, the enumeration of organisms in air, micro-organisms in water, and characteristics of deep-sea fishes The first edition was issued about two years ago. In the present facts up to date

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions ex-pressed by his correspondents. Neather can he undastake to return, or to correspond with the worsters of, rejected manuscripts intended for this or any other part of NATURE.

No notice is taken of anonymous communications 1 County Councils and Technical Education,

Your article of April 30 (vol. xlni p 602) is scarcely fair to the London County Coun

When you allege that the Council "have 'grabbed' a fund, sur-marked for educational purposes," you assume the question at issue. The only way in which the fund in question is "ear-marked" for educational purposes is by a clawe in the Act which gives each Council a discretionary power to supply the fund either to those purposes or to other purposes, as they

choose.

London, which, as proved by Mr. Coschen, is exceptionally rated, has come badly off in the general scramble for imperial doles which are devoted to the allevation of rates, and if the representatives of London ratepayers treat this additional folder out of the beer and spirit dulies as a make up for their con-

out of the ever and spire duties as a make up lot their com-paratively small share of other dole, they are doing not only I believe, however, that amongst those who voted against the plan proposed by the Committee of the Council there are many who would not be unwilling to see the money devoted to educa-tion, if any well-considered and reasonable plan were proposed

for this purpose.

But there are several questions which have to be answered

But there are several questions which have to be answered before this can be done properly.

What do the promoters of "technical education" mean by that term. It is not to be the teaching of the elementary that term. It is not to be the teaching of the elementary that the promoters are the properly of the elementary that the properly of the elementary that the properly of the elements of farming. The counties say, "Tolytechnics", the statute say, "Individend the elements of farming," the London County Council Committee say, "Tolytechnics", the statute say, the elements of the bungs the public meant to the business of his but we need to bring the public meant to the business of his but we need to bring the public meant to the business of his but we need to be a made to the elements of the state of the elements of the

De a practice.

Then, again, is it wise for the London Connty Council, which has work enough on its hands in looking after the physical condition of this great City, to take upon itself a task for which it is in no way fitted, and which was not contemplated when it was in no way fitted, and writer was not contemplated when a was elected. It is wast to must de administration by first intrasting elected to the waste of the state of the state

London Conneil exeremes a wise discretion in not committing itself to any scheme for appropriating this fund, the offspring of alegislative fluke, to any special and permanent object.

You speak, as persons in general speak, of the London County

You speak, as persons in general speak, on the London Lounds, council as one amongst other County Council. The name County Council is a mismoner which leads to constant error. The London County Council has institute or nothing in common with the bodies which have taken the place of the old megitarity in most district. It is really the cheff Town Council of the largest city or aggregation of clies in the world, and the rules and reasoning which, under the fill-frawn and dill-righested Local and reasoning which, under the fill-frawn and dill-righested Local control reasoning which, under the fill-frawn and dill-righested Local control reasoning which, under the fill-frawn and dill-righested Local control reasoning which, under the fill-frawn and dill-righested Local control reasoning which, under the fill-frawn and dill-righested Local control reasoning which, under the fill-frawn and dill-righested Local control reasoning which the fill-frawn and dill-righested Local control reasoning which the control reasoning which the control reasoning which the control reasoning which is the control reasoning which th and reasoning which, under the ill-drawn and ill-digested Local

appropriate. Calling London a county is the parent of endless mistakes; and to abuse the London Council because it is no acting in the same way as the Councils of counties seem dispose to set is no less confused than unfair. May 5.

The Alpine Flora.

I HAD not intended to continue the discussion on this subject, but Prof. Henslow's last letter calls for a few remarks. My

argument, summed up, 18 as follows :-

(1) Alpine plants as a class show certain characters, e.g. dwarfing and compact growth
(2) These characters are advantageous to them. or are gor-

related with such as are advantageous. (3) Although dwarfing, &c , may be produced as the direct

(3) Atthough dwaring, &c., may be produced as the direct result of environment (e.g. poor soil), there is normal variability in respect to size, time of maturing, &c. (4) When in cultivation those plants are selected which show a natural tendency to dwaring, &c., it is found that the charge-ter is inherited, and in this way, dwarfed, early-maturing, and

other peculiar races can be produced

(5) On the other hand, when plants have been dwarfed from growing in poor soil, or otherwise as the result of environment acting directly upon them, there appears to be no evidence to

show that the peculiarity is inherited.

(6) Supposing natural selection to be the only factor, it is (b) Supposing matural selection to be an additionally, to produce the complex cheered to far at they are heightary. At least, so

it seems to me.

To illustrate the point, take Mertensia again To illustrate the point, take Merientia again in Colorado, M. ulbrita grows in ravines, &c., by creeks, it could not pos-sibly grow in the same way above timber-line, with its tall stems and abundant foliage. Yet it gams much advantage in the creek bottoms from its height and rank growth; if it were adwarf, it would be almost or allogether smothered. Above species, M lancelata Thus we have two species frequenting different situations in the same district each is fitted for its station, either, removed to the station of the other, could not exist, In Arctic regions, M sibirica has produced a dwarf variety called drummondis, which is, I suppose, a first step towards the establishment of a dwarf Arctic species

Prof Henslow asks why, if natural selection eliminates tall plants on Alpine summits, it does not also do so lower down? I am not at all clear that it does not, in some cases For I am not at an erear that it does not, in some cases. For example, why is it this plants growing on exposed sea-shores have a tendency to he upon the ground or otherwise to evade the violence of the winds? But when a plant is growing among others, it has to compete with them in raising itself into conspicuousness, and any slight disadvantage from exposure to the winds would be more than compensated by the advantage of being able to spread its flowers and foliage in the sunlight and attract invects

The only plant of any size I found above timber-line on the Sangre de Cristo Range was Chicus exoceptalus, a wonderful

Sangre de Cristo Range was Centra state platfar, a wonderful great thatie, which pare throughout flowers, which are watered by humble-been. But this plant in very prickly and conceal to say on a gegante dwarf, in a, though it scena paradornal to say on a gegante dwarf. The typerdul from the far is coloned, on a finded but very creak as very help altitudes in Coloned, on a finded but very creak as very help altitudes in Coloned, on a finded but very creak as very help altitudes. The coloned, on a finded but very creak as very help altitudes. The same time species, anguirifides in not asserted of from arrays. Now I parsy is coming into calli-vation, it would be micretum to see whether it could be modified to a superfider and how far such modification would be micretum or anguirifier. such modification would be inherited There are other matters one might discuss, but I think I have

Inter are other matters one might discuss, our a table 1 are askeredly written enough 1 merely sak, will Prof. Heaslow give a case in which the direct effect of environment Asi produced inherited dwarfing? Will he sho show that natural selection cannot produce a dwarfed variety, or that artificial selection has not?

T. D. A. COCKERELL.

3 Fairfax Road, Bedford Park, Chiwarck, W., April 27.

MR THISELTON-DYFE, in his interesting letter in NATURE (p 581) does not mention one of the striking theracteristics of the Alpine flora—the remarkable brilliancy of the flowers, as compared with those borre by the same or similar species in Engised. A comparison of this kind made by the memory is no doubt not severely scientife, but those tourists in Switzerland who are in the half of observing flowers will probably confirm who are in the half of observing flowers will probably confirm the confirmation of the confirmation rapout, that makes the colours of lowes nowers so origin. The same, or, I should assert from memory, even greater, brilliancy, will be found in Arctic and sub-Arctic Norway by anyone who visits the Throndhjem district and the coast to Hammerfest in Western Norway notoriously is one of the moistest parts of Europe, but, on the other hand, it has, broadly speaking, no night at midsummer It is thus apparently the quantity, and the quality, of the sunlight that causes the peculiarly vivid colours of Swiss flowers, including those of the pastures from 2000 feet upwards. I have never been in Switzerland in spring, and I cannot therefore judge whether the colours of the flora in the lower districts are also more brilliant than ours; but it will be seen below that Swiss observers find that the high Alpine flora

our great national garden at Kew is peculiarly hadju stuated for the growth of Alpines The situation is low and foggy, and mild muggy weather alternates with night frosts. Above all, the smoke pall of London is peculiarly destructive in connection smoke pail of London is peculiarly destructive in connection with the other diavdamanages of the site. Alpine plants, as Mr. Dyer shows, are, in their natural state, at rest under a cloak of snow during the winter. The least warmth, however, statis them into growth, and the marvellously rapid flowering of many kinds in the oose on the melting of a snow-bed, is one of the most curious sights of the Aligs. The Kew climate (and the general English one too, though to a lesser degree) keens the plants in growth in winter. Then fogs, smoke, and damp collect on the young growth. These enumies are peculiarly liable to attach themselves to the numerous sorts with hairy or woolly

leaves. Then follow night frosts, and the young growth perishes. The application of these remarks is, that it does not follow that, because cold frames are necessities in the culture of Alpines at Kew, they should be used elsewhere in England There has at New, Incy should be used exemines in Segant. Incre has been a long discussion recently on this very point in the guidening papers, and the general belief appears to be, that give a fairly day climate cold frames are injurious, because they excite and keep plants in growth when they should be a treat A sheet of glass suspended over a plant in the open air, so as to shoot off our superfluous rain and to keep off some of our fog, snoot our superfluous rain and to keep oft some of our fog, appears to be much better, for premature growth 1. not stimulated. Alpines should so far as practicable be kept as dry as we can in winter, by drainage, light soil, &c. Theu when growth commences, say in March, they should be well watered each day. Commences, say in march, they should be well wastered sent my claims; it is raining), early in the morning. The plentiful mosture thus supplied to some degree takes the place of the melting snow, and it has dred off before the evening frosts sewe upon the leaves. The plants thus can grow freely in the day because they are surrounded with a moist atmosphere, and they because they are surrounded with a moist atmosphere, and they are kept "stocky" (in gardener's phrase) by the cold at sight, just as they are in fact on the Alpv. Thus it he plan recommended by that great authority M II Corrévon, of the Jardin Alpin d'Acclimatation, Geneva In the direc climate of that Alpin d'Acclimatation, Geneva In the there climate of that the cold, M Corrévon replaces the wow blanket of the Alpa by pine bough fastened closely over his Alpines In England this would, I sear, only make the planet voc. It does not follow that, pile bodiga lakernee closely over an Apines — an Laguan une because may plant in finnes at Kee grow long and citagging and lose their natural habit, they do so in England generally in the because may plant in finness at Kee grow long and citagging and lose their natural habit, they do so in England generally in the pose at. The changes in the habit of Alpines for largely due to the control of the control of

se trawent transportés là-hast sont-elles parées de couleur bien plas wres, hen plus pures qu'elles ne sont cher nons "
M. Corréon gues a number of instances in support of tha, which I will not quote here. In conclusion, in Mr. Dyer correct with the capture of a slight filler on the top." I am aware that when you get to considerable elevations the subsoil in forces now that the exception of a slight filler reason for the well-known mortisary on the Great St. Bernard was that bodies could not be built of the subsoil in forces that the subsoil in forces of the subsoil in force mortisary on the Great St. Bernard was that bodies could not be built of the subsoil of the forces of the subsoil of the force of scool force, and force the subsoil of the forces of the subsoil of the force of the force of the force of the force of scool force, and force the subsoil of the force of scool forces and force of the force of the force of scool forces and force of the force of the force of scool forces and force of the force of scool forces of the forces of scool forces of Alps is frozen, it would not apparently be so where trees grow, and it would be interesting to know the line of subterranean frost, and at what depths below the surface it is permanent at

various elevations. I. INNES ROGERS. Chislehurst, April 27

Co-adaptation

I DO not propose to extend the discussion on this subject beyond the present communication, but I cannot refrain from calling attention to the remarkable discrepancy in the position taken by Dr. Romanes in his last letter (April 23, p and that in his former communication (March 26, p 489), in which he says.—"I do not . hold myself responsible for and that in his former communication (March 20, p 489), in which he says. —"I do not. hold myself responsible for enunciating Mr. Herbert Spencer's argument, which the quotation sets forth. I merely reproduced it from him as an argument which appeared to me valid on the side of 'use inheritance.' For not only did Darwin himself invoke the aid of such inheritance, are in regard to this identical case . . . &c " If words have any meaning, this implies that Dr. Romanes agrees with Darwin any meaning, this implies that Dr. Romanes agrees with Darwin in regarding this case as one in which "use inheritance" played a part. Now, after I have endeavoured to show that this supa part Now, after I have endeavoured to show that this sup-posed case of co-adaptation can be explained without the aid of "use inheritance" at all, Dr. Romanes says that there is no difference of opinion on this point between us I can only say that I am very glad to learn this admission on his part, but why did be quote the argument from Herbert Spencer as "vald on the aid of "use inheritance," "If he did not believe it to be a case of true co-adaptation?" My My Dotta.

High and Low Level Meteorological Observatories.

I HAVE read with much interest your article of the 11th inst I MAVE read with much interest your article of the 11th uses on the results obtained by simultaneous observations in the meteorological observatories at the base and at the summit of Ben News . Ben News invest to a height of only 4370 feet above the sea, and yet we find that the comparison of these observations gives results of a knot that could not be obtained from any using gives results of a kind that could not be obtained from any number of stations all on the same level. Might we not hope for still more valuable results from similar observatories placed at the base and the summit of Eina and Tenerifie? Eina is 10,870 feet high, and Tenerifie 12,200. These would be better than any Alpine stations, because of their perfect isolation Belfast, April 25. JOSEPH JOHN MURPHY.

An "International Society"

An institution with the grandiloquent title of "The Inter-national Society of Literature, Science, and Art," which appears now to be largely totuing for subscriptions, publishes in its prospectus a list of the "Honorary Council," among whom appears "Professor Flower." As I am the only person in this

specias." Professor Flower." As I am the only person in this country to whom such a description could be applicable, and as many of my finends have inquired of me whether I have really given my support to the institution, I, wrote to the secretary to inquire by what authority the name appeared, and received the regime by what authority the name appeared, and received the "Sift." Whe special professor of gibts of action wides the receipt of your favour of Saturday. The gentleman to whom you refer is the well-known Professor Ogliby Flower, of New York. I am sorry the coincidence should have caused you any annoyance. In future printings of our recopectual the Chartsian name shall be inserted, Although this letter was dated March 9 last, I find that the prospectus continues to be usued unchanged, otherwise

catalogue and the property of British Museum (Natural History), May 2, 1891.

ON SOME POINTS IN THE EARLY HISTORY OF ASTRONOMY

X/E have next to deal with the astronomical relations of the horizon of any place, in connection with the worship of the sun and stars at the times of rising or setting, when of course they are on or near the horizon, and in order to bring this matter nearer to the ancient monuments, we will study this question for Thebes, where they exist in greatest number and have been most accurately described

The French and Prussian Governments have vied with each other in the honourable rivalry of mapping and each other in the nonourance rivary of imapping and describing the monuments. The French went to Fgypt at the end of the last century, while the Scientific Commission which accompaned the army, a Commission appointed by the Institute of France, published a series of volumes containing plans of all the chief temples in the valley of the Nile, as far as Phile.

In the year 1844, after Champolhon had led the way in deciphering the hieroglyphics, we became almost equally indebted to the Prussian Government, who also sent out a Commission to Egypt, under Lepsius, which equalled the French one in the importance of the results of the exploration, in the care with which the observations were made, and in the perfection with which they were recorded. Hence it is that in attempting to get informarenored. rience it is that in attempting to get informa-tion from ancient temples it is wise to study the region round Thebes, where the information is so abundant and is ready to our hand.

We have then to consider an observer on the Nile at Thebes, and to adjust things properly we must rectify the globe to the latitude of 25° 40', or, in other words, incline the axis of the globe at that angle to the wooden

It will be at once seen that the inclination of the axis to the horizon is very much less than in the case of London Since all the stars which pass between the North Pole and the horizon cannot set, all their apparent movement will take place above the horizon. All the stars between the horizon and the South Pole will never rise Hence, stars within the distance of 25° from the North Pole will never set at Thebes, and those stars within 25° of the South Pole will never be visible there. At any place the latitude and the elevation of the pole are the same. It so happens that all these places with which archæologists have to do in studying the history of early peoples, Chaldea, Egypt, Babylonia, China, Greece, &c, are all in middle latitudes, therefore we have to deal with bodies in the skies which do set and bodies which do not, and the elevation of the pole is neither very great nor very small. In each different latitude the inclination of the equator to the horizon as well as the elevation of the pole will vary, but there will be a strict relationship between the inclination of the equator at each point and the elevation of the pole. Except at the poles themselves the equator will cut the horizon due east and due west. Therefore everything to the north of the equator which rises or sets will cut the horizon between the east or west point and the north point; those bodies which do not set will of course not cut the horizon at all.

The sun and stars near the equator, in such a latitude as that of Thebes, will appear to rise or set at no very considerable angle from the vertical; but when we deal with stars rising or setting near to the north or south

From shorthand notes of a course of lectures to working men deferred.
The point were revised by in a sit desert during the month of January. The point were revised by in a sit desert during the month of January. The point and point in admit point point point and point p

points of the horizon they will seem to skim along the horizon instead of rising directly.

Now it will at once be obvious that there must be a

strict law connecting the position of the sun or a star with its place of rising or setting. Stars at the same distance from the celestial pole or equator will rise or set uniance from the celestial pole or equator will rise or set at the same point of the horizon, and if a star does not change its place in the heavens it will always rise or set in the same place. Here it will be convenient to introduce one or two technical terms. we generally define a star's place by giving, as one ordinate, its distance in degrees from the equator, this distance is called its deck-Further, we generally define points on the horizon by dividing its whole circumference into 360°, so that we can have azimuths of 90° from each pole to the east and west points We also have amplitudes from the east and west points towards each pole. We can say then that a star of a certain declination will rise or set at such an azimuth, or at such an amplitude. will apply to both north and south declinations

The following table gives the amplitudes of rising or setting (north or south) of celestial bodies having declinations from o' to 64° ; bodies with higher declinations than 64° never set at Thebes if they are north, or never rise if they are south, as the latitude (and therefore the elevation of the pole) there is nearly 26°

> Amplitudes at Thebes.

Declinati n	Amplitude at Thebes	Declination	Amplitude at Thebes
Declination O I 2 3 4 5 6 7 7 8 9 9 100 II 12 12 16 II 18 16 II 19 20 21 22 23 24 24 25 5 27 29 20 30 31 31 32 32	Amphrade at I hebes 0 1 7 2 13 3 20 4 5 33 4 5 43 5 43 7 47 11 13 11 27 11 23 11 32 11 32 12 13 13 22 14 32 15 41 17 49 18 55 18 18 32 19 9 19 9 10 22 17 20 3 20 3 20 12 21 22 17 23 44 24 53 24 44 27 27 28 44 27 27 28 44 27 28 45 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28 41 28	Declination 33 34 33 34 33 35 30 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 55 56 66 62 63	Amplitude at Theber 17 11 38 21 39 31 40 42 43 35 40 43 47 55 40 125 50 125 51 12 52 57 53 14 53 57 54 60 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 58 12 5
32	36 1		

This being premised, we now pass to the yearly path This being premised, we now pass to the yearry pain of the sun, with a view of studying the relation of the various points of the horizon occupied by the sun at different times in the year. In the very early observations that were made in Egypt, Chaldrea, and elsewhere, when the sun was considered to be a god who every morning got into his boat and floated across space, there was no particular reason for considering the ampli-tude at which the boat left, or came to, shore. But a few centuries showed that this rising or setting of the sun in widely varying amplitudes at different parts of the year

depended upon a very definite law. We now, of course, more fortunate than the early Egyptians, know exactly what this law is. We saw in the last lecture that not many years ago Foucault gave us a means of demonmany years ago roucaut gave us a means of demon-strating the fact that the earth rotates on its axis We have also a perfect method of demonstrating that the earth not only rotates on its axis once a day, but that it moves round the sun once a year, an idea which was undreami of by the ancents. As a pendulum shows us the rotation, so the determination of the aberration of light demonstrates for us the revolution of the earth round the sun.

We have, then, the earth endowed with these two movewe have, usen, the earth encowed with these two move-ments—a rotation on its axis in a day, and a revolution round the sun in a year. To see the full bearing of this on our present inquiry, we must for a time return to the globe or model of the earth

To determine the position of any place on the earth's surface we say that it is so many degrees distant from surrace we say that it is so many degrees distant from the equator, and also so many degrees distant from the longitude of Greenwich we have two rectangular co-ordinates, latitude and longitude. When we conceive the earth's equator extended to the heavens, we have a means of determining the positions of stars in the heavens exactly similar to the means we have of determining the position of any place on the earth. We have already defined distance from the equator as north or south declination in the case of a star, as we have north latitude or south latitude in case of a place on the earth. With regard to the other co-ordinate, we can also say it is at a certain distance from our first point of measureis at a certain distance from our first point of measure-ment, whatever that may be, along the celestial equator; speaking of the stars we call this distance right ascension, as speaking of matters earth; we measure from the meridian of Greenwich and call this distance longitude

The movement of the earth round the sun is in a The movement of the earth round the sun is in a plane which is called the plane of the ecliptic, and the axis of rotation of the earth is inclined to that plane at an angle of something like 23½. We can if we choose use the plane of the ecliptic to define the positions of the stars as we use the plane of the earth's equator In that case we talk of distance above the ecliptic as celestial latitude, and along the ecliptic as celestial longitude. The equator, then, cuts the ecliptic at two points one of these is chosen for the start-point of measurement along either the equator or the ecliptic. It is called the first

point of Aries

We have, then, two systems of co-ordinates, by each of which we can define the position of a star in the heavens : equatorial co-ordinates dealing with the earth's equator, ecliptic co-ordinates dealing with the earth's orbit. Knowing that the earth moves round the sun once a year, the year to us moderns is defined with the most absolute accuracy. In fact, we have three years, we have a sidereal year—that is, the time taken by the earth to go through exactly 360° of longitude, we have what is called the tropical year, which indicates the time taken by the earth to go through not quite 360°, to go from the first point of Aries till she meets it again; and since the equinoctial point advances to meet the earth, since the equinocular point advances to meet the earning, we talk about the precession of the equinoces; this year is the sidereal year migus twenty minutes; then there is also another year called the anomalistic year, which depends upon the movement of the point in the armin's orbit where the earth is nearest to the sun; this is running away, so to speak, from the first point of Anes, instead of advancing to meet it, so that in this case we get the sidereal year plus nearly five minutes.

The angle of the inclination of the earth's plane of

The angre or toe incumation of the cartins points or fortain to the plane of its revolution round the sun, which, as I have said, is something like 23%, is called the obliganty of the etilipie. This obliquity is subject to a slight change; food years ago it was over 24.

slight change; 6000 years, ago it was over any In order to give a concrete idea of the most important

points in the yearly path of the sun round the earth, I have here four globes representing the earth, with another nave here four globes representing the earth, with another globe in the middle representing the sun, showing the four practically opposite points of the earth's orbit, in which the north pole of the axis is most inclined to the sun, the north pole of the axis is most inclined away from the sun; and the two opposite and intermediate points where the axis is not inclined to or from the sun, but is at right angles to the line joining the earth in these two positions.

A diagram (Fig. 6) shows what will happen under these conditions. If we take the two points at which the axis, instead of being inclined towards the sun, is inclined at right angles to it, it is perfectly obvious that we shall get a condition of things in which the movement of the earth on its axis will cause the dark side of the earth



Fig 6 -Diagram showing the equality of the sun's centh distance at the two equinoves N, north pole of the carth, N, south pole, Z, remith of Greenwich

and also the light side represented by the side nearest to the sun both being of equal areas, to extend from pole to pole, so that any place on the earth rotating under to pole, so that any place on the earth rotating under those conditions will be brought for half a period of rota-tion into the sunlight, and be carried for half a period of the rotation out of the sunlight; the day, therefore, will be of the same length as the night, and the days and

nights will therefore be equal all over the world
We call that the period of the equinoxes; the nights
are of the same length as the day in both these positions

of the earth with regard to the sun, But in Fig. 7 we have a very different condition. but in Fig. 7 we have a very different condition. The the north pole is inclined at the greatest angle of 23½ towards, and away from, the sun if I take a point very near the north pole, that point will not, in summer, be carried by the earth's rotation out of the light,



Fig 7 —Diagram abowing the variation of the sun's zanith distance from solutioe to solutioe n, north pole of the earth s, south pole, z, zenith of Green such

and a part equally near the south pole will not be able to get into it. These are the conditions at and near two other points called the solstices.

In each of these globes I have placed a wire to represent the overhead direction from Jermyn Street, London, and if I observe the angle between this direction of the zenith to the sun in winter I get a considerable one; but if I take the opposite six-monthly condition and take the same zenith point, I get a very small angle. In other words, under the first condition the sun will be far from the zenith of Jermyn Street, we shall have winter, and in the other condition the sun will be as near as it can be to the zenith of Jermyn Street, we shall have summer These two points represent the two points in the earth's orbit at which the sun has the highest declination north or south. With the greatest north declination the sun will come up high, appear stationary for a day or two, as it does at our summer solutice, and then go down again, at the other point, when it has the greatest southern declination, it will go down to the lowest point, as it does in our winter, stop, and come up agam—that is, the sun will stand still, and the Latin word solutice exactly expresses that idea. We have then two points when the point of the sun at the latin word solutice exactly a considered that the sun at noon, two others when the have equal altitudes of the sun at noon, two others when the actual to the sun at the equinoxes and the greatest and the least at the equinoxes and the greatest and the least at the estimate of the sun at the solution. The change of declination will be supported to the solution of the sun at the equinoxes the sun by the san set most to the north in sentinger and most to the south in winter. At the equinoxes the sun has always of Decl, so it rises and sets due east and west all over the world. But at the solutions that it is a supported to the solution of 235° No 75°, it will the sun at the solution of the sol

I attrude of place	Anoplande of sup at soltne
25	26 5
30	27 24
35	29 8
40	31 21
45	34 40
50	38 20
55	44 0

At Thebes, representing Egypt, we find that the sun's azimuth at the summer solstice will be 26° N of E. at rising, and it will be 26° N of W at setting

These solstices and their accompanies are among the string things in the natural world. In the winter solstice we have the depth of winter, in the summer solstice we have the depth of summer, while at the equinoves we have but transitional changes; in other words, while the solstice point out for us the conditions of greatest heat and greatest cold, the equinoves point out for us those are very nearly equal, although of course in the one case we are saying good-bye to aummer and in the other to winter. To people who live in tropical or sub-tropical countries a summer solstice is a very much more definite thing than it is to us. In Egypt the summer solstice was paramount, for it herafield the rise of the Nile. Next came the autumnal equinos, for it marked the height of

Did the ancients know anything about these solstices and these equinoses? That is one of the questions which we have to discuss. Dealing with the monumental evidence in Egypt alone, the answer is aboutled your-whelming. The evidence 1 propose to bring before you then been also also also before the propose to bring before you make the propose to bring before you will be a supply that the propose to bring before you have the proposed to be a supply that the proposed with the proposed to be a supply that the proposed with the propo

First a word as to the general plan of a temple such as we find it in Egypt. They may be arranged a rothecturally into two main groups. Edfou is the most perfect example of one of the first group, characterized by having a pylon consisting of two massive structures right and left of the entrance, which are somewhat like the two towers that one sometimes be consistent to west from the order of our English and the state of our English and the state of the entrance when the entrance when the entrance is the entrance when the entrance is the entrance of th

at Thebes is another example (Fig. 8).

From the entrance-pylon the temple goes stretching adopt through various halls of different sizes and details until at last at the extreme end of the temple what is

called the Sanctuary, Naos, or Holy of Holies, is seached. The end of the temple at which the pylons are distated is open, the other is closed. These lofty towers, and indeed the walls, are sometimes covered with the most wonderful drawings and heroglyphic figures and records. Stretching in front of the pylons, extending sometimes very far in front, are rows of sphunes. This principles



Fig. 5 —Plan of the Temple of Ramses 11 in the Memn ma at Thebes (from Leps us), showing the pylon at the open end, and the sanctuary at the closed ons.

ciple is carried to such an extent that in some cases separate isolated gates have been built right in front and exactly in the alignment of the temple. At Karnak there really are two such temples back to back, and the distance which separates the outside entrances of both is greater than the distance from Pall Mall to Piccadilly; the great temple covers about twice the area covered by

St. Peter's at Rome, so that these were temples of a vastness absolutely unapproached in the modern world.

In Denderah we have an example of the second group, in which the massive pylon is omitted. In these the front is entirely changed; instead of the pylon we have now an open front to the temple with columns—the Greek form of temple is approached (Fig 9).

1 shall not have time to get to the astronomical side of

I shall not have tune to get to the astronomical side of the Greek temples in this course of lectures, but I an anxious to take this opportunity to refer to the transition from the Expyrian form of temple to the Greek one. The east front of the Parthenon at Athens very much more resembles the temple of Denderah than it does the early Expyrian temple—that is to say, the eastern front is open; it is not closed by pylone.

In many Egyptian temples, in the progress from one end to the other, one goes through various halls of different styles of architecture and different stages of magnificence But in the Greek temple this is entirely changed, the approach to the temple was outside, the temple representing, so to speak, the core, almost the Holy of Holes, of the Egyptian temple, and any magnificent approach to it.



Fig. 9 +Plan of the Pemple of Denderal (from Lepasus), showing the absence of a pylon

which could be given, was given from the outside. But although they were quite different in their aspects, they were quite similar in their objects. Some Egyptian temples took bundreds of jears to build, the obelisks were all in single blocks like that on the Embankment, and all were brought for hundreds of miles down the Nile A temple meant to the Egyptians a very serious thing indeed.

So much, then, for a general idea of an ancient temple.

Another point is very striking in these temples, notably in the chief one at Karnak.

From one end of the temple to the other we find the ansa marked out by narrow apertures in the various pylons, and many walls with doors crossing the asis. There are 17 or 18 of these immiting apertures, and in the other temple which is back to back to this one we have bloom as exactly the same way limiting the light which blooms in exactly the same way limiting the light which blooms in exactly the same way limiting the light which construction gives one a very definite impression that every part of the temple was built to subserve a special object, via. to limit the sualight which fell on its front into a narrow beam, and to carry it to the other extremity of the

temple—into the strictuary—which extremity was always blocked. There is no case in which the beam of light can pass absolutely through the temple.

The idea is strengthened by considering the construction of the astronomical telescope. Although the Egyptams knew nothing about telescopes, it would seem that they specially about telescopes, it would seem that they special arrangement in the modern telescope—they wanted to keep the light pure, and to load it into their sancuary, as we lead it to the eyeptec. To keep the light that masses into the evenence of a modern telescope pure, we



F17 to -The axis of the Temple of Karnak, looking south east, from outes the north west pylon (from a photograph by the author).

have between the object-glass and the eyepiece a series of what are called diaphragms; that is a series of rings right along the tube, the inner diameters of the rings being greatest close to the object-glass, and smallest close to the eyepiece, these diaphragms must so be made, that all the light from the object-glass shall fall upon the made.

upon the eyepiece, without loss, or reflection by the tube.
These apertures in the pylons and separating walls of
Egyptian temples exactly represent the diaphragms in
the modern telescope.
J NORMAN LOCKYER.

(To be continued.)

HERTZ'S EXPERIMENTS

I N the last article, a general method of measuring the velocity at which a disturbance is propagated was described. It depended on being able to produce a regular succession of disturbances at equal intervals of These were made to measure their own velocity by reflecting them at an obstacle. Then, by the inter-ference of the incident and reflected waves, a succession of loops and nodes are produced at intervals of half the distance a disturbance is propagated during the time between two disturbances. It is a general method ap-phrable to any sort of disturbance that takes time to get from one place to another. It has been applied over and over again to measure the rate at which various kinds of over again to ineasine the rate at which various kinds of disturbance are propagated in solids, liquids, and gasses. It was applied in a modified form years ago, to measure the length of a wave of light, and, within the last'year, some of the most beautiful experiments on photography ever described are applications of this principle by Herr Wiener and M. Lippmann.

There are three things essential to this experiment : (1) some method of originating waves, (2) some method of reflecting them, (3) some method of telling where there are loops and where there are nodes. We will take them in this order—

(1) How can we expect to originate electric waves? If, when a body is electrified positively, the electric force due to it exists simultaneously everywhere, of course we cannot expect to produce anything like a wave of electric force travelling out from the body, but if, when a body is suddenly electrified, the electric force takes time to reach a place. we must suppose that it is propagated in some way as a wave of electric force from the body to the distant place This, of course, assumes that there is a medium which is in some peculiar state when electric force exists in it. and that it is this peculiar state of the medium, which we call electric force, existing in it, that is propagated from one place to another lt must be carefully borne in mind what sort of a thing this is that we call the electric force at any place. It is not a good name—electric intensity
would be a better one, but electric force has come so much into use, it is hardly to be expected that it can be eradicated now Electric force at any place is mea-sured by the mechanical force that would be exerted at the place if a unit quantity of electricity were there is not a force itself at all; it is only a description of the condition of the medium at the place which makes elec-tricity there tend to move. The air near the earth is in such a condition that everything immer-ed in it tends to move away from the earth with a force of about 1'26 dynes for each cubic centimetre of the body, se. each cubic centimetre tends to move with a force of 1 26 dynes. Now the condition of the air that causes this is never described as volume force existing at the place, though we do describe the corresponding condition of the ether as electric force existing there; and as volume force existing would be a very objectionable description of the condition of the air when, being at different pressures at various levels, it tends to make bodies move with a force proportional to their volume, so electric force existing is a very objectionable description of the condition of the ether, whatever it is, that tends to make bodies move with a force in proportion to their electric charges We know more about the structure of the air than we do about the ether. We know that the structure of the air that causes it to act in this way is that there are more molecules jumping about in each cubic centimetre near the earth than there are at a distance, and we do not know yet what the structure of the ether is that causes it to act in this remarkable way; but even though we'do

not know the nature of the structure, we know some of its effects, by means of which we can measure it, and we can give it a name. Although we know very little indeed about the structure of a piece of stressed india-rubber, yet we can measure the amount of its stress at any yet we can measure the amount or its stress at any place, and can call the india-rubber. In this peculiar condution "stressed india-rubber." As a matter of fact, we know a great deal more about the peculiar condition of the ether that we describe as "electric force." existing than we do about the "stressed india-rubber" and there is every reason to suppose that the structure of the ether is, out of all comparison, more simple than that of india-rubber

When sound-waves travel through the air, they consist of compressions followed by rarefactions, and between them the pressure varies from point to point, so that here we have travelling forward a structure the same as that we nave traveling forward a structure the same as impleted to the air near the earth, and waves of sound might be described as consisting of a succession of positive and negative "volume forces" travelling forward in the air this form of expression would no doubt be objectionable, but still if all we knew about the properties of the air near the earth was that it tended to make bodies move away from the earth with a force proportional to their volume, it is quite likely that this condition of affairs near the earth might have been described as the existence of a "volume force" near the earth, and when it was discovered that this action was due to a medium, the air, it would have been quite natural to describe this state of the air as "volume force" existing in it. and then when waves of sound were observed it would be quite natural that they should be described as waves of "volume force," especially if the only way in which we could detect the presence of these waves was by observing the force exerted on bodies immersed in it, which was proportional to their volumes, and which we happen to know is really due to differences of pressure at neighbouring points in the air. We do not know what is the structure of the ether that causes it to exert force on electrified bodies, but we know of the existence of this property, and when it is in this state we say that "electric force" exists in it, and we have certain ways by which we can detect the existence of "electric force," one of which is the production of an electric current in a conductor, and the consequent electrification of the conductor, and if this is strong enough we can produce an electric spark between it and a neighbouring conductor. When a conductor is suddenly electrified, the structure of the ether which is described as electric force existing in it travels from its neighbourhood through the surrounding ether, and this is described as a wave of electric force travelling through the surrounding ether. It is desirable to be quite clear as to what is meant by the term a wave of electric force. and what we know about it We know that it is a region of ether where its structure is the same as in the neighbourhood of electrified and some other bodies, and owing to which force is exerted on electrified bodies, and electric

currents are produced in conductors.

We may, then, reasonably expect that, if it is possible to electrify a body alternately positively and negatively in rapid succession, there will be produced all round it waves of electric force—that is, if the electric force is propagated by, and is due to, a medium surrounding the electrified body, if electrification is a special state of the medium that fills the space between bodies.

(2) The next question is. How can we reflect these waves? In order to reflect a wave, we must interpose in its way some body that stops it. What sort of bodies stop electric force? Conductors are known to act as complete screens of electric force, so that a large conducting sheet would naturally be suggested as the best way to reflect waves of electric force. Reflection always occurs when there is a change in the nature of the medium, even though the change is not so great as to

* Continued from vol xhii. p. 538 NO. 1123, VOL 44]

stop the wave, and it has long been known that, besides the action of conductors as screens of electric force, different non-conductors act differently in reference to electric force by differing in specific inductive capacity. Hence we might expect non-conductors to reflect these waves, although the reflection would probably not be so intense from them as from conductors. Hence this expection of how to reflect the waves is presty easily solved. We are acting still on the supposition that there is a simultaneously of course their will be no weaves to tree flect, and, consequently, no loops and nodes produced by the interference of the incident and reflected waves.

(3) The third problem is. How can we expect to detect where there are loops and where there are nodes? Recall the effects of electric force. It tends to move electrified bodies If, then, an electrified body were placed in a loop, it would tend to vibrate up and down. This method may possibly be employed at some future time, and it may be part of the cause of photographic actions, for these have recently been conclusively proved to be due to electric force: but the alternations of electric force from positive to negative that have to be employed are so rapid that no body large enough to be easily visible and electrithat no body large enough to be easily visible and electri-fied to a reasonable extent could be expected to move sufficiently to be visibly disturbed. It is possible that we may find some way of detecting the vibrations hereby given to the electrified ions in an electrolyte; and it has recently been stated that waves originated electrically shake the elements in sensitive photographic films sufficiently to cause changes that can be developed. The other action of electric force is to produce an electric current in a conductor and a resultant electrification of the conductor. Two effects due to this action have actually been used to detect the existence of the wave of electric force sent out by a body alternately electrified positively and negatively. One of these is the heating of the conductor by the current Several experimenters have directly or indirectly used this way of detecting the electric force. The other way, which has proved so far the most sensitive of all, has been to use the electrification of the conductor to cause a spark across an air-space This is the method Hertz originally employed, A priori, one would not have expected it to be a delicate method at all. It takes very considerable electric forces to produce visible sparks. On the other hand, the time to produce visible sparss. Of the other hand, the total the force need last in order to produce a spark is something very small indeed, and hitherto it has not been possible to keep up the alternate electrifications for more than a minute fraction of a second, and this is the reason why other apparently more promising methods have failed to be as sensitive as the method of producing sparks. If two conductors be placed very close to one another in such a direction that the electric force another in such a direction that the electric force is in the line joining them, their near surfaces will be oppositely electrified when the electric force acts on them, and we may expect that, if the force be great enough, and the surfaces near enough, an electric spark will pass from one to the other. This is roughly the arrangement used by Hertz to detect whether there are loops and nodes between the originator of the waves and the reflector.

Now arses the problem of how to electrify the body alternately positively and negatively with sufficient rapidity. How rapid is "with sufficient rapidity"? To answer this we must form some estimate of how rapidly we may expect the waves to be propagated. According to Maxwell's theory, they should go at the same rate as light, some 300 million of metres per second, and it is evident that if we are going to test Maxwell's theory we must make provision for sufficiently rapid extric vibrations to give some result if the waves are propagated at this encomous rate. The distance from a mode to a node in half the distance a wave travels during

a vibration. If we can produce vibrations at the rate of 300 million per second, a wave would go I metre during a vibration, so that, with this enormous rate of alternation, the distance from node to node would be 50 cm. We might expect to be able to work on this scale very well. or even on ten times this scale, ie, with alternations at the rate of 30 million per second, and 5 metres from node to node, but hardly on a much larger scale than this It almost takes one's breath away to contemplate the production of vibrations of this enormous rapidity Of course they are very much slower than those of light these latter are more than a million times as rapid; but 300 million per second is enormously more rapid than any audible sound, about a thousand times as fast as the highest audible note. A short bar of metal vibrates longitudinally very fast, but it would have to be about the thousandth of a centimetre long, in order to vibrate at the required rate. It would be almost hopeless by mechanical means to produce electric alternations of this frequency. Fortunately there is an electric method of producing very rapid alternate electrifications Leyden iar is discharged through a wire of small resistance, the self-induction of the current in this wire keeps the current running after the jar is discharged, and re charges it in the opposite direction, to immediately discharge back_again, and so on through a series of olscharge back again, and so on through a series of alternations. This action is quite intelligible on the hypothesis that electrification consists in a strained condition of the ether, which relieves itself by means of the conductor Just as a bent spring or other strained body, when allowed suddenly to relieve itself, relieves itself in a series of vibrations that gradually subside, similarly the strain of the ether relieves itself in a series of gradually subsiding vibrations. If the spring while relieving itself has to overcome frictional resistance, its vibrations will rapidly subside, and if the friction be sufficiently great, it will not vibrate at all, but will gradually subside into its position of equilibrium In the same manner, if the resistance to the relief of the strain of the medium, which is offered by the conducting wire, be great, the vibrations will subside rapidly, and if the resistance of the wire be too great, there will not be any vibrations at all. Of course, quite independently of all frictional and viscous resistances, a vibrating spring, such as a tuning-fork that is producing sound-waves in the air which carry the energy of the fork away from it into the surrounding medium, will gradually vibrate less and less. In the same way, quite independently of the resistance of the conducting wire, we must expect that, if a discharging conductor produces electric waves, its vibrations must gradually subside owing to its energy being gradually transferred to the surrounding medium. As a consequence of this the time that a Leyden jar takes to discharge itself in this way may be very short indeed. It may perform a good many oscillations in this very short time, but then each oscillation takes a very very short time To get some idea of what quantities we are dealing with, consider the rates of oscillation which would give wave-lengths that were short enough to be con-veniently dealt with in laboratories 300 million per second would give us waves one metre long; consider what is meant by 100 million per second. We may get some conception of it by calculating the time corresponding to 100 million seconds It is more than 3 years and 2 months. The pendulum of a clock would have to oscillate 3 years and 2 months before it would have performed as many oscillations as we require to be performed in one second The pendulum of a clock left to itself without weights or springs to drive it, and only given a single impulse, would practically cease to vibrate after it had performed 40 or 50 vibrations, unless it were very heavy, i.e had a great store of energy or were very delicately suspended, and exposed only a small resistance to the air. A light pendulum would be stopped by com-

municating motion to the air after a very few vibrations. insultating instout to the air after a very lew violations. The case of a Leyden jar discharge is more like the case of a mass on a spring than the case of a pendulum, because in the case of the Leyden jar there is nothing quite analogous to the way in which the earth pulls the pendulum : it is the elasticity of the ether that causes the electric currents in the Leyden jar discharge, just as it is the elasticity of the spring that causes the motion of the matter attached to it in the case notion of the matter attended to it in the Case
of a mass vibrating on a spring. It is possible to
push this analogy still further Under what conditions
would the spring vibrate most rapidly? When the spring
was stiff and the mass small. What is meant by a spring being stiff? When a considerable force only bends it a little. This corresponds to a considerable electric force only electrifying the Leyden jar coatings a little, s.e to the Leyden jar having a small capacity. We would consequently expect that the discharge of a Leyden jar with a small capacity would vibrate more rapidly than that of one with a large capacity, and this is the case In order to make a Leyden iar of very small capacity we must have small conducting surfaces as far apart as possible. and two separate plates or knobs do very well. The second condition for rapid vibration was that the mass moved should be small. In the case of electric currents what keeps the current running after the plates have become discharged and recharges them again is the socalled self-induction of the current. It would be well to look upon it as magnetic energy stored up in the ether around the current, but whatever view is taken of it, it evidently corresponds to the mass moved, whose energy keeps it moving after the spring is unbent and rebend the spring again Hence we may conclude that a small self-induction will favour rapidity of oscillation, and this To attain this we must make the distance the current has to run from plate to plate as short as possible. The smaller the plates and the shorter the connecting wire the more rapid the vibrations, in fact, connecting wire the more rapid the viorations, in sact, the rapidity of vibration is directly proportional to the linear dimensions of the system, and for the most rapid wibrations two spherical knobs, one charged positively and the other negatively, and discharging directly from one to the other, have been used Hertz in his original investigations used two plates about 40 cm. square, forming parts of the same plane, and separated by an interval of about 60 cm. Each plate was connected at the centre of the edge next the other plate with a wire about 30 cm. long, and terminating in a small brass knob
These knobs were within 2 or 3 mm. of one another, so
that when one plate was charged positively and the other negatively they discharged to one another in a spark across this gap. An apparatus about this size would produce waves 10 or 12 metres long, and its rate of oscillation would be about 30 million per second As the vibration actually produced by these oscillators seems to be very complex, the rate of oscillation can only be described as "about" so and so In a subsequent investigation Hertz employed two elongated cylinders about 3 cm. long and about 3 cm. in diameter, the remin-ated by knobs about 4 cm. in diameter, and discharging directly into one another. Such an oscillator produces waves from 60 to 70 cm. long, and, consequently, vibra-tions at the rate of between 400 and 500 million per second. Most other experimenters have used oscillators about the same dimensions as Herrz's larger apparatus, as the effects produced are more energetic; but many experiments, especially on refraction, require a smaller wave to be dealt with, unless all the apparatus used be on an enormous scale, such as could not be accommodated in any ordinary laboratory. When we are thus aiming at rapid rates of vibration, it must be recollected that we cannot at the same time expect many vibrations after each impulse. If we have a stiff spring with a small weight arranged so as to give a lot of its energy to the

surrounding medium, we cannot expect to have very surrounding medium, we cannot expect to have 'very much energy to deal with, nor many vibrations, and, as a matter of fact, we find that this is the case. The total duration of a spark of even a large Leyden jar is very small. Lord Rayleigh has recently illustrated this very beautifully by his photographs of failing drops and breaking bubbles. We cannot reasonably expect each spark to have more than from 10 to 20 effective oscillations, so that, even in the case of the slower oscillator, the total duration of the spark is not above a millionth of a second. It is very remarkable that the incandescent air, heated to incandescence by the spark, should cool as rapidly as it does, but there is conclusive evidence that it remains incandescent after the spark proper has ceased, and con-sequently lasts incandescent longer than the millionth of a second. What is seen as the white core of the spark may not last longer than the electric discharge itself certainly does not do so in the case of the comparatively very slowly oscillating sparks that have been analyzed. into their component vibrations by photographing them on a moving plate The incandescent air remaining in the path of such discharge is probably the conducting path through which the oscillating current rushes backwards and forwards Once the air gap has been broken through, the character of the air gap as an opponent of the passage of electricity is completely changed. Before the air gap breaks down, it requires a considerable initial difference of electric pressure to start a current. Once it has been broken down, the electric current oscillates backwards and forwards across the incandescent air gap until the whole difference of electric pressure has subsided, showing that the broken air gap has become a conductor in which even the feeblest electric pressure is able to produce an electric current if this were not so, Leyden jars would not be discharged by a single spark All this is quite in accordance with what we know of air that is, or even has lately been, incandescent . such air conducts under the feeblest electric force All this is most essential to the success of our oscillator Only for this valuable property of air, that it gives way suddenly, and thenceforward offers but a feeble opposition to the rapidly alternating discharge, it would have been almost impossible to start these rapid oscillations If we wish to start a tuning fork vibrating, we must give it a sharp blow it will not do to press its prongs together and then let them go slowly, we must apply a force which is short-lived in comparison with the period of vibration of the fork. It is necessary, then, that the air gap must break down in a time short compared with the rate of oscillation of the discharge, and when this is required to be at the rate of 400 million per second, it is evident how very remarkably suddenly the air gap breaks down. From the experiments themselves it seems as if any even minute roughnesses, dust, &c, on the dis-charging surface, interfered with this rapidity of breakdown, it seems as if the points soluttered out electricity and gradually broke down the air gap, for the vibrations originated are very feeble unless the discharging surfaces are kept highly polished, gilt brass knobs act admirably if kept polished up every ten minutes or so. One of the greatest desiderata in these experiments is some method of making sure that all the sparks should have the same character, and be all good ones.

(To be continued.)

THE ROYAL SOCIETY SELECTED
CANDIDATES.

THE following fifteen candidates were selected on Thursday last (April 30), by the Council of the Royal Society, to be recommended for election into the Society. The ballot will take place on June 4, at 4 p.m. We print with the name of each candidate the statement of his qualifications.

WILLIAM ANDERSON.

V.-P last M.E. M I.C.E. Consulting Engineer, Royal Agricultural Society of England. Popil of the late Sir William Fairbaim, F. R.S. Member of the firm of Messrs Courtney and Stephens, Engineers, of Dublin, from 1855 to 1864 President, in 1863, of the Inst. of Civil Engineers of Feland, to and Stephens, Canadienes, or Jennin, 1990. The stephens of the Society of the Communicated important papers. "On the Theory of Braced Gurden," "The Strength of Railway Bridges of Small Span, and the Cross hearns of Large Hridges," and other subjects. Between 1932 and 1885, communicated many permittens on Sugar Mandacture, in Upper Egypt, by the Sulphurout Acid Process, "Experiments and Observations on the Simsson of Heath y Illowater Pupes," and "Purish the Sulphurout Acid Process," "Experiments and Observations on the Simsson of Heath y Illowater Pupes," and "Purish the Author Purish of the Sulphurout Acid Process, "Experiments and Observations on the Simsson of Heath y Illowater Pupes," and "Purish the Author Purish of Heath y Illowater Pupes, "and "Purish the Author Purish Canadian State of the International Control of Heath and the James Watt Gold Medal of the Into C. F. Author of a Tecture on "The Generation of Steam," hency one of Ibe a Lecture on "The Generation of Steam," hency one of Ibe and the International Control of a Tecture on "The Generation of Steam," hency one of Ibe and the International Control of Lectures delevered at the being the substance of a course of Lectures delivered at the Society of Arts under the "Howard Irust", of a paper on "New Applications of the Mechanical Properties of Cork," communicated as a Lecture to the Royal Institution, and of various papers communicated to the Inst. of Mcchanical Engineers, the Royal Agricultural Society, & Distinguished for the ability with which he has applied his intimate knowledge of the science of heat, and other counsie sciences, to the practical requirements of the engineer.

FREDERICK ORPEN BOWLE, D Sc (Camb).

FREDERICK OFFEN HOWLE, D Sc (Camb), FLLS, F. R.S. F. Regus Professor of Honey in the University of Clasgow Distinguished for his researches in intological and morphological honey. Author (in conjunction Hardward) and the Collaboration of th some Normal and Abnormal Developments of the Oophyte in wome Normal and Nomorma Development of the Normal spirit and Nymeko-ghilous Plant "(Tram Phil Soc Glasg) "The Comparation of the Meritems of Ferns as a Phyl genetic Study "(Annah of Ros., 1889); "On the Morphology of the Leaf of Nepenthes" (tible); "On Antithetic as distinct from Leaf of Nepenthes" (tible); "On Antithetic as distinct from John Monitors (1912.); "On Antinetic as distinct from Homologous Alternation of Generations in Plants" (bids, 1890) Translator (in conjunction with Dr. D. H. Scott) of "Comparative Anatomy of the Phanerogams and Ferns," by Anton de Bary (Clarendon Press, 1884).

SIR JOHN CONROY, Bart, M A.,

F.C.S. Lecture on Physics and Chemstry, Keble College, Oxford. An aamdoust Student of Experimental Science, and suther of the following papers—"On the Devoted of Calcium student of the following Chem. Soc., 1873)." On the Points at the Points of Calcium of Light by Journal of Proc. Roy. Soc., 1896). "Absorption Spectra of Indian" (Proc. Roy. Soc., 1896). "On the Light reflected by Poissaum Permanganase" (Paul. Mag., 1879): "Experiments on Heatin the Visible Spectrum" (Paul. Mag., 1879): "Experiments on Metallic Reflexion" (Pecc. Roy. Soc., 1971, 1879), 1889.

DANIEL JOHN CUNNINGHAM, M D (Edin), M.D. (Dublin), F.R.C.S.L., F.R.S.E., F.Z.S., Professor of Anatomy, University of Dublin Distinguished both as a

NO. 1127, VOL. 44

teacher and original inquirer. Examiner in Anatomy in the Universities of London, Edinburgh, and Disbin. Member of Council, Royal Irish Academy. Vice-Pres Zoological Society, Ireland. Vice-Pres, Anatomical Society of Great Britain and Ireland Author of numerous anatomical memoirs in journals and publications of scientific societies. More especially may be and publications of scientific societies. More especially may be mentioned—"Report on the Anatomy of the Marsupulia," (Challenger Report, Part 16),..." The Lumbar Curve in Man the Royal Irn's Anatemy, 1886,..." The Spiral Nervous System of the Porpone and Dolphin." (Gront. Anat. Physiol., 1876). Author of a Text-book of Irractical Anatomy.

GEORGE MERCER DAWSON, D Sc.

GEORGE MERCER DAWSON, D. Sc.,
F. G.S., A. R. S. M., F. R. S. C. Assistant Director, Geological
Survey of Canada. Much important and valuable work, more
expecually in geology and shinology, a. in the following summary
statement: Daring his bittere they trugged in working out the
varvey (Canada, has been rehely) trugged in working out the
Placed in charge of the Vision Expedition, 1887. Author of
memorant papers, chiefly geological, but including geographical,
ethnological, and other observations, published in the Quart,
Journ Geol. Doe, I rans Key Doe Canada, Canadan Naturu
Jour, &c. These deal more especially with the superficial
and a their misconnic organisms. Author of fifteen general
and after misconnic organisms. Author of fifteen general geology of the ragions explored, but some describs. Poraminifera and inther microscopic organisms, Author of fifteen reports published by the Geological Survey of Canada, and joint author (with Dr Selwyn) of a Descriptive Section of the Physical Geography and Geology of Canada, and (with Dr W F Tolme) of Comparative Vocabularies of the Indian Tribes of British Columbia

EDWIN BAILEY ELLIOTT, MA,

Fellow of Queen's College, Oxford Vice President of the London Mathematical Society Mathematical Lecturer of Queen's and Corpus Christi Colleges Distinguished as a Queen's and Corpus Christ Colleges Distinguished at a Mathematican and original investigator in various branches of mathematical research. Author of the following pipers "clienterilation of Prevot and Linduler's Thoorem in Chances." (Ed. Timer, vol. xxxv); "On Normals to Livelopes, "Gibbs, "Christian Colleges, "Christian Christian, "District Christian," (Ed. Timer, vol. xxxv); "On Normals to Livelopes, "Christian Christian, "District Christian, "District Christian, "District Christian, "Normalican Christian," "Mathighe Fruilianam Integrabs," (Ind., vol. xv., p. 147); "Multiple Fruilianam integrabs," (Ind., vol. xv., p. 147), "Multiple Fruilianam with One Degree of Freedom," (Mat., of Math., vol. vv., p. 35), "The Linear Parint Inferential Equations of Systems with One Degree of Freedom," (Mat., of Math., vol. vv., p. 35), "The Linear Parint Inferential Equations and State Christian, "District Christian," (Proc. vol. 147), "On the Interchange of the Variables in certain Learn District Linear District Christian," (Proc. vol. 147), "On the Interchange of the Variables in certain Learn District Linear District Christian," (Proc. vol. 147), "On the Interchange of the Variables in certain Christian," (Proc. vol. 147), "On the Interchange of the Variables in certain control of the Christian Christian," (Proc. vol. 147), "On the Interchange of the Variables in certain control of the Christian Christian," (Proc. vol. 147), "On the Interchange of the Variables in certain control of the Christian Christian," (Proc. vol. 147), "On the Interchange of the Variables in certain control of the Christian Christian," (Proc. vol. 147), "On the Interchange of the Variables in certain control of the Christian Christian," (Proc. vol. 147), "On the Interchange of the Variables in certain control of the Christian Christian," (Proc. vol. 147), "On the Interchange of the Variables in certain control of the Christian Christian Christian," (Proc. vol. 147), "On the Interchange of the Variables in certain control of the Christian Christian xviii, p. 142), "On the Interchange of the Variables in certain Linear Differential Operators" (Abstract, Roy Soc. Proc, vol xiv., p. 338 [ordered to be printed in the Phil Trans]), and eighteen other paper, printed in the London Mathematical Society's Proceedings and elsewhere between the years 1875 and rSon.

PERCY FARADAY FRANKLAND, B Sc.

ARSM, PhD Professor of Chemistry Formerly Senior Demonstrator in the Chemical Laboratory of the Normal Schools Demonstrator in the Chemical Laboratory of the Normal Schools of Science, South Kensington Author of upwards of twenty original papers in the Phil Trans and Proc Roy Soc, in the Jonnals of the Chem Soc, the Soc of Chem Industry, &c. Known for his researches on Bacteriology and on the Chemical Aspects of Fermentation.

PERCY C GILCHRIST.

A R S M Metallurgat Datinguished as a Metallurgial, expecually in connection with the manifactifie of ron and steel In association with the late Mr. S. C. Thoms he greatly added to the control of the c ARSM Metallurgist Distinguished as a Metallurgist, and elsewhere

WILLIAM DORINSON HALLIBURTON, M.D., R.Sc., WILLIAM DOBINSON HALLIBURTON, M.D., B.Sc., Assistant Frofessor of Physiology in University College, London Has during the past four years devoted his entire time to research work in, and teaching of Physiology, specially the chemical communications:—"On the Protected of Serum" (Froc. Roy. Soc., and Journ. of Physiol., 1831, 100 the Chemical Composition of Investebrate Carniage, "(Froc. Roy. Soc., 1835, and Quart. March. March. March. March. 2014). The Composition of Investebrate Carniage, "(Froc. Roy. Soc., 1835, and Quart. March. Marc cation to Physiol. Soc., 1887)

OLIVER HEAVISIDE.

OLIVER HEAVISIDE,

Learned in the science of electro-magnetium, having applied higher mathematics with power and success to the developments of Maswell's theory of electro magnetic wave propagations of Maswell's theory of electro magnetic wave propagations of the propagation of the following papers among many others—"On Electro magnetic Endersion and in Fropagation "i. de parts, 1824—81; "On the Electro-magnetic Effects due to the Motion of Electrication through a Delicertic ("Alia", Mag., 1883—13; "On the Electro-magnetic Effects due to the Motion of Electrication through a Delicertic ("Alia", Mag., 1889—13); "On the Electro-magnetic Effects due to the Motion of Electrication through a Delicertic ("Alia", Mag., 1889—13); "On the Electro-magnetic Effects due to the Motion of Electrication through a Delicertic ("Alia", 1889—13); "On the Electro-magnetic Effects due to the Motion ("Alia", 1889—13), "On the Electro-magnetic Effects due to the Motion of the Medium"; "On the Work of Cells with Condensers" ("Pair, Mag., 1874), "On the Electro-magnetic Effects of the Medium"; "On the Work of Cells with Condensers" ("Pair, Mag., 1874), "On the Electro-magnetic Effects of the Effect of Faults on the Speed of Working Calles", "On Electro-magnetic Micro-Rock 1874, "On Electro-magnetic Effects of Seatts on the Speed of Working Calles", "On Electro-magnetic Effects of Seatts on the Speed of Working Calles", "On Electro-magnetic Effects of Seatts on the Edward 1877, "On Induction between Parallel Wires" (their).

JOHN EDWARD MARR, M.A (Cantab),

JOHN EDWARD MARR, M.A (Cantab),

JOHN ETWARD MARR, M.A (Cantab),
F.G.S. Fellow and Lecture of St. John's College, Cambridge,
and University-Lecture in Geology First Class Nat Sci.
Tripos, 1878; Sedewick Presents, 1883; Examer for the
Nat Sci. Tripos, 1886-89. Secretary of the Geological Society
Sci. Secretary of the Geological Society
Control of the College of Control of the College of Control
Phosphatical Carbonate of Lime at Cave Ha." (Ced. Mag., 1879), "On Some well defined Life-cones in the lower part of
the Shirman of the Lake Durict." (Quart Journ Geol Soc., 1879), "On Locambrian and Stienan Rocks of the Valley,"
1879), "On some Sections of the Lover Platerone Rocks of the
Caven Durict." ("Yor Vork. 1608 Soc., 1882 and Brit. Assoc. 15001]. 'On some Section's of the Lower's insteaded Rocks of the March 1881). "The Cassification of the Cambrum and Silarnan Rocks." (Gool. Mag., 1881). "On the Lambrum and Silarnan Rocks." (Gool. Mag., 1881). "On the Lambrum and Silarnan Rocks." (Gool. Mag., 1881). "On the Lambrum and Silarnan Rocks." (Sedgwick Prez Essay, 8vc, Cambridge, 1883). "The Earth Hatory of the Remote Past compared with that of Recent Jimes." (Seo., Cambridge, 1884). "The Earth Hatory of the Remote Past compared with that of Recent Jimes." (Seo., Cambridge, 1884). "The Earth Hatory of the Remote Past compared with that of Recent Jimes." (Seo., Cambridge, 1884). "On some Affects of Freezew on the Theory of the Cambridge, 1884). "On some Affects of Freezew on the Cambridge, 1884). "On some Affects of Freezew on the Cambridge, 1884). "The Metamorphum of the Fishelgebre," (Ind., 1889). "The Metamorphum of the Skiddaw Shates" (Brit. 1880). "The Lower Palescone Rocks of the Metamorphum of the Skiddaw Shates" (Brit. 1880). "The Lower Palescone Rocks of the Metamorphum of the Skiddaw Shates" (Brit. 1880). "The Skiddaw Shates" (Brit. 1881). "The Skiddaw Shates" (Brit. 1881). "The Skiddaw Shates" (Brit. 1882). "The Skidd Craven District" (Proc Yorks, Geol Soc, 1882, and Brit. Assoc,

LUDWIG MOND.

F.I.C President of the Society of Chemical Industry, W.-P. Chem. Soc. Disamguished technical chemist and inventor Has NO. 1123, VOL. 44]

made important additions to chemical industrial processes and made important additions to chemical industrial processes and products, especially with reference to the sital industry, having products, as the products, and the products of development of the ammonia soda process of alkali manufacture into England Author of various papers in Rept. Brit Assoc., Journ. Soc. Chem Ind.

WILLIAM NAPIER SHAW, M A.,

Fellow of Emmanual College, Cambridge Was nominated by Lord Rayleigh as one of the Demonstrators of Physics in the Cavendish Laboratory at Cambridge. He held that position from 1880 to 1887, and he has since continued his connection with the Laboratory as University Lecturer in Physics. His knowledge of the manner in which the teaching of Physics is knowledge of the manner in which the teaching of Physics is conducted in the great German Universities (acquired at Berlin under Helmholtz) enabled him to bear an important part in the organization of the laboratory. A considerable part of the suc-cess of the Cambridge School of Physics is due to his exertions, cess of the Cambridge School of Physics is due to his exertions, backed by his knowledge of Physics. Author of immerous backed by his knowledge of Physics. Author of immerous of notice—"Practical Physics" (jointly with Mr. Glazdrood), Longmans, 1883, "Practical Work in the Cawendh Laboratory," Unsternity Press, 1860, "Faraday's Law of Electrolysis "Electrolysis" and "Pyromater," "Engy: Brill," 1"On Vapermeters," & C., Rept. to the Meteorol. Council, 1884, "On Higgmenter Methods, Part.," "Rept. to the Meteorol. Council, printed in Phil Trans

SILVANUS PHILLIPS THOMPSON, D Sc (Lond).

SILVANUS PHILLIPS TROMPSON, D Sc (Lond), Principal and Professor of Physics in the City and Gould of I ondon Technical College, Finshury; formerly Professor of I ondon Technical College, Finshury; formerly Professor of I ondon Technical College, Principal College, Bristol, Author of many papers published in the Proceedings, &c., Royal Sonetty, Physical Society, institution of Electrical Engineers, Society, of Theory of the Magnetic Balance "(Proc. Roy. Soc., 1884); "Electro-deposition of Alloys" (Wald., 1887), ""Opacity of Tourishine Crystal", (Ind., 1881), "The Measung of the Constant and Crystal", (Ind., 1881), "The Measung of the Constant and Crystal", (Ind., 1881), "The Measung of the Constant and Crystal", (Ind., 1881), "The Measung of the Constant of Mag., 1883), "Development of the Mercural Air Panja" (Journ Soc., 1884), "Development of the Mercural Air Panja" (Journ Soc., 1884), "New York (Indiano Control Constant of Con more particularly in its experimental and technical aspects.

THOMAS HENRY TIZARD, Staff-Commander, R.N.,

FR.GS. Distinguished as a Hydrographical Surveyor and Marine Meteorologist. Has been employed for 25 years in the Naval Surveying Service. In China, Mediterranean, and Red Seas, 1862-72. Senior Assastant-Surveyor in the Challenge Seas, 1860-72 Senor Amstant-Surveyor in the Chalinger Lapedition, 1879-70. Prepared the reports on the sea tem-lapedition, 1879-70. Prepared the reports on the sea tem-taged the report of the reports of the sea temperature of the season o

THE ENDOWMENT OF RESEARCH IN FRANCE

A T the meeting of the Paris Academy of Sciences on April 27, the Secretary read the following extract from the will of the late M. Cahours:

"I have frequently had the opportunity of observing, in the course of my scientific career, that many young men, distribution of the course of my scientific career, as we themselves obliged to abandon it because at the beginning they found no effections help which provided them with the first necessities of life and allowed them to devote themselves exclusively to scientific studies

"With the object of encouraging such young workers, who for the want of sufficient resources find themselves powerless to finish works in course of execution, and in remembrance of my heloved children, who also would walk in a scientific path at the moment when death takes me from them, I bequeath to the Academy of Sciences, which has done me the honour to admit me into its fraternity, a sum of one hundred thousand francs "I desire that the interest of this sum may be distributed

every year by way of encouragement to any young men who

more particularly by chemical researches

"In order to assure this preference, independently of the express recommendation that I make here to my successors, I wash that, during at least venty-five years after the commencement of the interest payable to the Academy, three members at least of the Chemistry Section may take part each year in a Commission of five members charged by the Academy to distinct the property of the payable the prizes. I express further the formal desire that this commission on new members charged by the Academy to distinct the prices. I express further the formal desire that this choice should fall, as far as possible, on young men without fortune not having aslaried offices, and who, from the want of a sufficient situation, would find themselves without the possibility of following up their researches.

of following up their researches.

"These pecuniary encouragements ought to be given during several years to the same young men, if the Commission thinks that their productions have a value which permiss such a favour "Nevertheless, in order that the largest number of young

aveverinciess, in order that the largest number of young workers may participate in the legacy I institute, I desire that the encouragements may cease at the time when the young seasants who have enjoyed them obtain sufficiently remunerative positions

M Janssen then made the following remarks -

"The legacy which has been made to the Academy, by our very eminent and very regretted confield, appears to me to have considerable import not only by its importance, but especially by the way that it opens, and the example that it affords, to all those who hereafter may desire to encourage the sciences by their

"M Cahours, whose sure judgment and long experience enabled him to know the most urgent necessities of science, had, like most of us, become convinced of the necessity of introducing a new form in the institution of scientific re-

"Our prizes will always continue to meet a great and noble accessity, their value, the difficulty of obtaining them, and the kédat they take from the illustriousness of the body which awards them, will make them always the highest and most

envised of recompenses.

"But the value, also, of the works it is necessary to produce in order to lay claim to them prohibits the research to beginners. It is a field that is only accessible to maured talents

"But, besides those savants who have already an assured career, there are many young men endowed with precious aptitudes, and directed by their inclination to pure science, but turned very often from this envied career by the difficulties of existence, and taking with regret a direction giving more immediate results. And yet, how many among them possess talents which, if well cultivated, might do honour and good to science !

"We must say, however, that it is in leaving their studies that those who wish to devote themselves to pure science experience the most difficult trials, and these difficulties are increased every day by the very rapid advance of the engencies of lete

"We must find a prompt remedy for this state of things of we do not wish to see the end of the recruitment of science. NO TIME VOL 447

"This truth, however, is beginning to be generally felt. The Government has already created institutions, scholarships, and encouragements, which partly meet the necessity. Some generous donors are also working in this manuer. I will mention especonformations a hall is at this moment being built, where whose intentions a nail is at this moment being built, where young men, having shown distinguished aptitudes for high administration, the bar, or history, will receive for three years all the means of carrying on high and peaceful studies.

"Let us say, then, plainly, and in speaking thus we only feebly echo the expressions of the most illustrious members of by Cahours that it is by following the way so nobly opened by Cahours that the interests and prospects of science will be most efficaciously served."

NOTES

A SPECIAL meeting of the Physical Society of London will be held at Cambridge on Saturday, May o The members will leave Liverpool Street at 11 a.m., and on arrival at Cambridge will become the guests of the Cambridge members meeting will be held in the Cavendish Laboratory at 2 30 The following communications will be read some experiments on the electric discharge in vacuum tubes, by Prof. J Thomson, F R S.; some experiments on ionic velocities. by Mr W C D Whetham, on the resistance of some mercury standards, by Mr R T Glazebrook, F R S , on an apparatus for measuring the compressibility of liquids, by Mr S Skinner, some measurements with the pneumatic hridge, by Mr W N Shaw After the meeting members will have an opportunity of seeing the Cavendish Laboratory and other University Laboratories.

THE annual meeting of the Iron and Steel Institute began vesterday, and will continue to day and to morrow. It is being held as usual at the Institution of Civil Engineers in Great George Street.

A VALUABLE bequest has been made to the Department of Science and Art by the late Miss Marshall, of 02 Warwick Gardens, Kensington In addition to a large number of scientific books and instruments which are left for the use of students. a sum of £1000 is bequeathed for the founding of scholarships, or for application in any other way that may be considered best for the advancement of biological science

THE Queen has approved the appointment of Lord Derby to be Chancellor of the University of Lundon, in the room of the late Lord Granville.

THE death of Prof Joseph Leidy, in his sixty eighth year, is announced. He was Professor of Anatomy in the University of Penusylvania and of Natural History in Swarthmore College . President of the Academy of Natural Sciences of Philadelphia; and Director of the Department of Biology in the University. In a future number we shall give some account of his services to science

A REUTER's telegram from New York, dated May I, announces the death, at Berkeley, California, of Prof. John Le Conte. brother of Mr. Joseph Le Conte, formerly professor of geology and natural history in the University of California.

WE regret to have to announce the death of Captain Cecilio Pujazon, the Director of the Marine Observatory of San Fernando, near Cadiz He died on April 15, in his fifty-seventh year. Captain Pujazon was well known to the members of the Eclipse Expedition of 1870, who formed the Cadiz party. He came to London to the Conference on Marine Meteorology in 1874

In answer to a question put by Mr H. Fowler in the House of Commons on Monday, Sir W. Hart Dyke said that from the returns already received, in answer to a circular issued by the Science and Art Department at the end of March last, it appeared that of the fifty county councils and sixty county boroughs in England, axteen of the former and twenty-five of the latter had already decided to apply the whole of their share of the residue under the Local Taxation (Customs and Exeise) Act of 1890 to science and art and technical education Nine county councils and two county boroughs had made grants varying from "nearly the whole" to a smaller proportion of their share to the same purpose Twelve county councils and seven county boroughs had the matter under consideration , that as to say, they had appointed committees, and in many cases the committees had recommended the allocation of the whole or the greater part of the residue fund to technical instruction, but their reports had not yet been confirmed by the county or borough councils With regard to Wales, the question was complicated by the fact that the Welsh Intermediate Education Act included seehnical instruction, but it appeared that four county councils and one county borough had applied the whole of their share of the residue under the Intermediate Education Act: while two county councils and one county borough had divided their quota between that Act and the Technical Instruction Act. The remaining six county councils had either made no return, or else had the matter under consideration.

THE Council of University College, Bangor, having resolved to make provision in the physical department (Prof. A Gray) for the study of applied electricity, an 8 horse-power (nominal) compound engine, working up to 24 horse-power, has just been installed by Mesars Robey and Co , Lincoln On Saturday last a satisfactory trial of the engine and boiler was made. The equipment includes a special educational Victoria dynamo (capable of being converted at will into a shunt, compound-wound, or series dynamo, without impairing its usefulness for general work), by the Brush Electrical Engineering Co., an alternating dynamo, and a large secondary battery The electrical measuring instruments are of the latest design, and include a fine composite balance, and electrostatic voltmeter of Sir William Thomson's invention. The equipment forms a valuable addition to the resources of the College for the teaching of pure and applied physical science, and will render it possible to give a very complete course of instruction in electrical engineering, as well as in the general theory of electricity.

THE Philosophical Society of Berlin offers a prize of 1000 marks for the best essay on the relation of philosophy to the emplrical science of nature The essays may be written in German, French, English, or Latin, and must be sent in before April 1. 180.

THE Italian Meteorological Society has celebrated its twentyfish anniversary by erecting a memoral table in the mediaval castle of Turin. The founder of the Society, Father Densa, and various notabilities and hidse were present. Father Densa gave a riment of the history of the Society, which now possesses no less than 250 observatores and stations. The cremony was terminated by the transmission of a telegram to the King, 34 Honorary Freident of the Society.

True Chief Signal Officer of the United States has published Part III. of "Bibliography of Mecorology," comprung tutter relating to the general motions of the atmosphere, or "winds," while the important divasion of "storms " is being prepared for inne as Part IV. The present volume, like its predocessors, is althographic reproduction of a copy prepared by means of a type-writer, as funds were not forthcoming for printing the work, and it constains stutial of zooo titles of books and sparen daming from the origin of printing to the close of 1881, with a suppliment to the close of 1889, and an author index. The work is quite unique, and will be an invaluable aid to the study of the subject treated of

NO. 1123, VOL. 44]

An account of the Birmingham School of Medicine, written originally for the moreasian of those members of the medical profession who attended the Birmingham meeting of the British Association in 1850, has now been published separately. The authors are Dr. B. C. A. Windle and Mr. W. Hillhouse. Their mentions to show—and thus they do most effectually—that the centre of the Midland district possesses one of the best equipped schools of medicine in the provinces. The interest of the descriptions is greatly increased by reproductions of some photographs.

A First and Game Communion, taking evidence on behalf of the Ontation Government, has received many complaints as to the destruction of deer and other depredations by wolves, and all the winnesses agree that the present bounty of £1 paut for each wolf killed should be rased to £2 100. or £3. It has also been shown that, if the game laws are not more strictly coforced, many birds and far bearing animals will probably be exterminated.

THE preliminary returns of the recent census operations in India show that the population in British territory is 220,400,000, as against 198,655,600 in the former census, an increase of nearly 22,000,000. The Feudatory States, omitting incomplete returns, which may be taken at about 90,000, have a population of 61,410,000, making a total of 281,900,000, as against 250,700,000 for the same areas at the last census The returns give Bombay 805,000, Madras 440,000, Calcutta municipal area and port 674,000, and including the suburbs Howrsh and Bally, 969,000. At the last census the total for the same area was 847,000 Calcutta municipal area shows an increase of 92,000, and Howrah and Bally an increase of 24,000. The returns from Burmah show that the population of the whole country, excluding the Shan States, is 7,507,063, or 48 8 persons to the square mile. The population of Lower Burmah alone 15 4,526,432, or an increase of about 700,000 since 1881

THE Boston Society of Natural History has usued a pamphlet announcing the completion of the general plans for the formation of zoological gardens and aquama in Boston, and appealing to the American public for support. The pamphlet is prettily printed and illustrated, and sets forth very effectively the arguments which may be advanced in favour of the scheme.

The new number of the Journal of the Royal Horticultural Society contains a full report of the Dahlin Conference, held at the Chiawuck Gardens on September 23 lad, and of the Grape Conference, held in the same Gardens on September 24. The number also contains valuable papers on various other subjects interesting to horticulturals.

THE Trustees of the Indian Museum, Calcuta, have issued an interesting and mixercitors; Report, by Mr. b. C. Cotes, on the locust of North Western India (Aerailum pregramus). The Report sums up the results of an investigation conducted in the entomological section of the Museum It seems to be stablished that most of the flights of this locust leuse from the region of sand hills in Western Rajpatana. Others, however, invade Indian from breefing grounds which probably he along the Sultination from the region of the Sultination of the Sultina

THE New Zealand Journal of Science, the publication of which was suspended in 1885, has been revived. The first two numbers of the new issue have been sent to us, and if the same general level of excellence can be maintained in faiture numbers, there ought to be no doubt as to the success of the enterprise. The following are among the papers: on the history of the Kiws, by Prof. T. J. Parker: on the breeding habits of the European sparrow in New Zealand, by T. W Kirk , the humblebee in New Zealand, by G M. Thomson ; some notes on the occurrence of the trap door spider at Lyttelton, by R M. Laing: on the discovery of the nickel-iron alloy Awarute, by Prof. G. H. F Ulrich.

In the paper on the humble-bee in New Zealand, Mr. Thomson says that, wishing to find how far these insects are adapting themselves to new flowers in the colony, he has for a considershle time kept a record of the flowers they visit and of those they leave alone. He has noticed them on many species of introduced plants which they never appear to visit in Europe, They seldom approach white flowers, and, with two exceptions, he has never heard of their visiting the flowers of indigenous plants The exceptions are Fuchnia excepticata and the Ngato (Myotorum latum).

MESSES. R. ETHERIDGE, JUN, AND MR A. SIDNEY OLLIFF have produced in common a paper which forms a valuable addition to the Memoirs of the Geological Survey of New South Wales. The title is "The Mesozoic and Tertiary Insects of New South Wales."

MESSES BAILUIRE, TINDAUL, AND COX publish a second edition of Dr Thomas Dutton's practical treatise on "Sea-Sickness." Sensible readers will at once be favourably impressed by the author's statement that there is "no absolute specific " for this distressing malady

MESSRs CASSELL AND Co have issued Part 21 of their "New Popular Educator," which will be completed in 48 parts Besides illustrations in the text, there is a carefully prepared page representing coloured reactions characteristic of certain

MR. T. H. CORNISH, of Penzance, has a note in the current number of the Zoologist on some remarkably large catches of fish on the Cornish coast On March 18 last, 12,000 grey mullet, Mugil capito, were captured, by means of a draw seine. by the fishermen of Senneu Cove, at Whiteand Buy, Land's End The fish were of fine quality, one being brought to Mr Cornish which measured 2 feet in length, I foot 3 inches in girth, and weighed 6 pounds 10 ounces. On the 31st of the same month a Lowestoft mackerel driver, fishing some leagues outh-west of the Lizard, took 48,000 mackerel No such catch of mackerel, for one night's fishing, had ever been heard of before it Penzance, and what makes it more extraordinary, says Mr Cornish, is that it should have taken place in March, when the atches usually average a few hundreds only. Later on in the season, in the fishing west of Scilly, 20,000 to 25,000 is regarded is a heavy catch. The catch sold for £ 160

WITH reference to our note (vol. xliii p 521) on an award made by the Japanese Government to Dr. Shohes Tanaka for "the invention of a new musical instrument," Mr. J. W Goundry, of Gosforth, Newcastle, writes to us that over twenty years ago he patented an arrangement for giving enharmonic intervals in all keys on the ordinary unaltered keyboard, and hat he has had both an organ of 31, and a harmonium of 36, sounds per octave, playing Bach's fngues and Handel's choruses, &c , on the system He claims that, although his patents were very crude and imperfect, they contain at least the germ of a complete solution of the problem of reconciling just intonation with the ordinary manual. "They embody a system of sounds." he says. " which I believe to be theoretically the truest and practically the simplest possible, and which has nowhere else been described "

AMMONIUM sulphovanadate, (NH4) VS4, has been isolated in large crystals by Drs Kruss and Ohnmais, and an account of NO. 1123. VOL. 44]

sulpho salts of vanadium, will be found in the latest number of Liebro's Annalen It is well known that when ammoniacalsolutions of vansdates are treated with sulphuretted hydrogen a magnificent purple colouration is produced, presumably due to the formation of sulpho-salis. It has not been found possible, however, to obtain such salts by crystallization in pacuo. The method of obtaining the ammonium salt now described is as follows -A stream of sulphuretted hydrogen is led into an icccold saturated solution of ammonium metavanadate, NH, VO, in the strongest ammonia. The immediate effect is to produce the violet-red colour, but the colouration soon disappears and a brown solid is precipitated On continuing the passage of the gas this precipitate slowly redissolves with production again of the deep violet colour. When the re solution of the precipitate is almost complete the liquid is filtered, and sulphureited hydrogen again led through the solution. In a short time crystals commence to separate, when the current of gas is stopped and the liquid left to crystallize in a closed vessel. The crystals thus obtained consist of opaque rhombic prisms very much resembling in appearance those of potassium permanganate. The faces are very brilliant and reflect a steel bluish-violet colour with a greenish tint when the reflection is received at a certain angle. They may be washed with absolute alcohol and afterwards with ether, and finally dried in vacuo. The mother liquors from the first crystallizations deposit magnificent crystals on being allowed to stand some weeks. The substance may be much more quickly obtained and in larger quantity by substituting either potassium or sodium vanadates for the ammonium vanadate used in the above mode of preparation, as these salts are much more soluble in ammonia than ammonium vanadnte. It is somewhat remarkable that in this case pure ammonium sulphovannulate should be obtained, no potassium or sodium sulpho salts being ever found in the product. The crystals of ninmonium sulphovanadate are permanent in dry air, but are slowly decomposed with evolution of sulphuretted hydrogen in most air. They are readily soluble in water, forming a solution which is coloured intensely violet even when very dilute. A solution containing only one part of the salt in 100,000 parts of water still pussesses a benutiful rose red colour. After a short time this solution decomposes, sulphuretted hydrogen being liberated and the colour changing to brown When a freshly prepared solution is added to a solution of a salt of the alkaline earthy metals, no precipitate is produced, owing to the solubility of the sulphovanadates of these metals. But in the case of calcium n remarkable deepening of the violet colour is produced. If, for instance, a little calcium chloride is added to a dilute solution possessing a just perceptible rose tint, the colour becomes immediately deep violet, owing to the extreme inctorial power of the calcium salt.

In our note in vol xliii p 592, upon the preparation among other silicon compounds of ailicon chloro-tribromide, SiClBra by M Besson, it was stated that this substance had not been hitherto prepared We wish to correct this statement. Silicon chloro tribromide was prepared by Prof. Emerson Reynolds in 1887, and a descriptive note of the work was given in NATURE nt the time (vol. xxxvi. p. 137).

THE additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (Macacus rhesus ?) from India, presented by Mrs. Emily Palmer, two Brazilian Caracaras (Polyborus brankensis) from Terra del Fuego, a Turkey Buzzard (Cathastes aura) from the Fulkland Islands, presented by Mr. F. E Cobb, C.M.Z S ; two Herring Gulls (Larus argentatus), British, presented by Mrs. Attenborough; a Pine Grosbeak (Penicola, enuclentor), British, presented by Mr. W. H St Quantin; a Bennett's Wallaby (Halmaturus bennetts &) from Tasmania, two Diamond Snakes (Merelia stulpter) from their work, which also includes the preparation of several other Australia, deposited, two Tasmanian Wolves (Thylacinus

cynocephalus & Q), three Ursine Dasyures (Dasyurus ursinus & 9 9) from Tasmania, two Brush Turkeva (Talegalla lathami & V), four Australian Wild Ducks (Anas superciliesa) from Australia, received in exchange : a Black Lemnr (Lemur macaco), two Persian Gazelles (Gazella subrutturesa), born in the Gardens

THE INSTITUTION OF MECHANICAL ENGINEERS.

O'N the evening of Thursday and Frinds of last week, the post of the state of the Institution of Mechanical English that and the last match the Institution of Mechanical English Institution, occupylishers and the Institution of the Institution of the Institution of the Institution of Mechanical Institution of the Institution of There were two items on the programme—namely, a paper on Lancashire boilers, and a further report from the Research Committee on Marine Engine Trials The discussion of the latter occupied so much time that the holler paper had to he shelved until next

The latest steamer upon which the Marine Engine Research The latest steamer upon which the Marine Engine Research Commission has been experimentally at eargor weed among the Hartlepool, and is a good modern example of what can be done in fuel economy with triple expansion engines when high speed is not aimed at. This latest report of the Committee should in the committee of the commi of the Meteor, Fust Yama, and the Colchester came out at not of the Medeer, Puss Yama, and the Colchester came out at not less than 2 pounds of coal per indicated horse-power per hour —the Colchester's consumption being nearly 3 pounds per hour—it was said, by those who had never believed in the claims of marine engineers, that the bubble was pricked by trial made by competent and unbassed persons. It is true the economical form of steam motor, for there can be no doubt that the engines of that vestel have given off on trial one unt of power per hour for less than the pound and a half of coal, and we have no reason to think that the 138 pound shown on the chief engineer's independent trial is not a fair average for sea running when the disturbing element of measuring lanks is omitted The Jona is a well decked vestel, built in 1859. She has

triple expansion engines on three cranks, working a single screw erpie expansion engines on tincre cranks, working a single screw lie vessel is 275 feet long, 37 3 feet wide, and 19 feet deep In the hold. Her moulded depth is 21 feet to inches, and her coefficient of fineness is 0 765. She has a cellular bottom. Her mean draught in dock before trial was 20 feet 8 inches, but she mean draught in dock before trial was 20 feet 8 inches, but she rose half an inch in sail water, the displacement being 4430 tons. The engines had been freshly overhauled The trial took place off the east coast, between Robin Hood Bay and Great Yarmouth. The weather was fine throughout. The engines Great Varmonth. The weather was fine throughout. The engines are ripple compound surface conficiently. The vyinders are but are replected to the control of are triple compound surface condensing. The cylinders are p

area through the tubes is 18'3 square feet, and the area acro the funnel 30 7 square feet. A notable feature about this vessel is that the bullers are worked on forced draught; or rather there is is that the Suders are worked on forced draught; or rather there is an faor supplying at toth fers, for a pressure equal to only 0'17, onch of water in the sak pats hardly fulfils the popular notion of forced draught. The attemfor driving flexian engane was supplied from the donkey botter, and therefore the measurement of quantities in the performance that The matter is not one of great importance—the power to drive the fan not being, person, but we question whether it is strictly affected that the same that the district of the power for the propelling engues, but we question whether it is strictly affected that the same tha main supply The boilers in this ship have an extra-ordinarily large proportion of tube surface as compared to the grate surface, and this would be likely to lead to an insufficiency grate suriace, and this would be likely to lead to an insufficiency of draught were the lighter specific gravity of the chumery gates alone depended upon II, therefore, the and of the fan last of the control of the c before the boiler, but not more so than the feed pumps; all boilers, however, must have feed-pumps, while comparatively few have fan-engines. If ever it comes to be that fan engines are simpost as many markets. almost as much matters of course as feed pumps, it will be convenient to class the former with the engine, but until then it is as well to estimate the steam required for forced draught purposes by itself, still it should be taken into account.

The air from the fans is taken to the furnace through gridlron valves, which close automatically when the furnace door is opened, so as to prevent a rush of flame into the stokehold. A openico, so as to prevent a rush of name into the stockehold. As small jet of ar is also admitted through the wet end of the boiler back by a passage made for the parpose. In this way there are two streams of are which meet in the combistion-chamber. There is also a hanging bridge attached to the back the plate, and depending into the flame box at the back of the put the cylindrical fities of modern high-pressure holders on an equality, in the matter of combastion, with the rectangular furnaces of the comfortable low pressure days of the past generation of marine engineers. At the same time we must not forget that a large amount of fuel burnt on a small gratte requires a large combustion chamber. It is the volume of gases evolved which has to be considered. It should be stated that the arrangement for forced draught was designed by Mr J. R. Fothergill, of Hartlepool, engineer superintendent to the firm owning the ship.

	Tons
Engines alone	94 92
Shafting, tunnel bearings, and propeller	26 59
Engine room auxiliaries, including donkeys,	
pipes, platforms, ladders, and graings	12 16
Boilers alone	58.60
Boiler-room auxiliaries, including forced draught	,
gear, smoke-box, uptake, funnel, furnace gear,	
mountings, stokehold floor, boiler-chocks,	
and ties ,	28 49
Water in boilers	35.75

The coal used was of good quality. The following analysis (as used) will be of interest .-

						Per cent
Carbon	•••	•••		••		82'34
Hydrogen						5'47
Mouture	***	**			**	1 94
Ash					•••	2'00
Nitrogen,	sulpho	r, oxygen	&c., by	differen	ce	7 35
						100.00

The calculated calorific value is 14,830 thermal units per pound, which corresponds to the evaporation of 15'35 pounds of water from and at 212° F. A portion of the coal used was also tested by a Thomson calorimeter, and gave a value of 14,980 tered by a Thomson Caronineer, and gave a value of surface gases were taken over mercury and were analyzed The following The following

Carhonic acid . Carbonic oxide .	By volume per cent . 8:20 0:00	By weight per cent 12 12 0 00
Oxygen	11.12	 12'01
Nitrogen	8o 63	75 87
		Briss annument
	100 00	100,00

are the means .--

Chimney temperatures were read every half hour by a mercury thermometer and by two Murne pyrometers at 30 feet above the furnace bars. The readings of the three instruments agreed, the average temperature being 452" F It was a pity that the readings were taken so far from the fires, it being desirable to know the heat of the products of combustion immediately after leaving the heating surface of the booler. The arrangement, however, was unavoidable, owing to the exigencies of running the ship on her voyage. The measurement of the feed was the ship on her voyage The measurement of the feed was carried out by means of two tanks in the usual way. An effort was made to determine the quantity of water brought over un-evaporated, by the draught of steam. This was done by taking samples of condensed steam from the steam pipe and samples of botter water, and analyzing them to ascertain the percentage of pairs of analyses male, it was estimated that there was 2 87 per cent of inevaporated boiler water in the condensed steam. If this were the case with hoilers so easily driven as those of the Iona, where there could hardly have heen any semblance of " as the term is understood by engineers, the quantity of water brought over in small and hardly driven boilers must be enormous It is a point of the greatest importance in steam-engine economy, and we trust Prof Kennedy will pursue his investigations in this direction. It also came out during the discussion that the stop valve, or throttle valve, was very much closed during the trial, a fact which should still further have reduced the chance of unevaporated water finding its way into the engines

the engines Indicator diagrams were taken every half-hour during the trial, and an average set is attached to the report. The power was very evenly distributed between the three cylinders, showing good design of the engines. The total indicated horse power was 645. Diagrams were also taken from the air and circulating pumps. For these interesting and valuable details we lating pumps For these interesting and valuable details we must refer our readers to the paper itself, as we are unable to

reproduce the diagrams

The following are some of the chief elements of the trial:

and tottowing are some of the cliter elen	ments of the trime —
Date .	July 13 and 14, 189
Duration of trial	16 hours
Heating surface, total	3160 square feet.
tubes .	
Grate area	
Total heating surface to grate surface	42 ,, ,,
Grate area to flue area through tubes	75 2 ratio.
Orace area to nue area through tubes	23 ,,
Mean boiler pressure above atmosphere	165'o lbs. per sq. 1
Mean admission pressure, high pressure	
cylinder	1425 ,, ,,
Mean vacuum in condenser below at-	
mosphere	13.88
Mean revolutions per minute .	61 1
I H.P. of high pressure cylinder .	205 6
,, intermediate	221'2
,, low-pressure	218 6
Coal burnt per hour .	942 pounds,
,, square foot of grate per	942 pounds.
	22'4 ,,
Coal barnt per square foot of total	_
heating surface per hour .	0.368 "
Coal burnt per I.H.P per hour	1'46 ,,
Carbon equivalent of coal	1'02 ,,
Feed water per hour	86160 ,,
, lb. of coal	9'15 "
from and at	"
212° F	10 63

NO. 1123, VOL. 44]

Efficiency of boiler 69'2 per cent. engine 17 1 engine and boiler Mean speed of vessel during trial 8 6 knots per hour

A long discussion, occupying both evenings of the meeting A long discussion, occupying both cramings of the feelings followed the reading of the paper, but our account has already extended to such a length that we cannot give a report of it. extended to such a length that we cannot give a report of it, Perhaps the most interesting point raised was in connection with the closing of the chimney damper, which it appeared was only that the such as the such as the such as the such as the that in this way heat was prevented from escaping up the chimney. It is difficult to account for such an effect, excepting perhaps to some firfulng extent due to minor causes, but several engineers whose opinion is worthy of respect testified that such was the effect in practice. One would think that the escape of heat by the chimney would be governed by the volume of escaping products of combustion with a chimney of any reasonable ornes aren

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE -The first Clerk Maxwell Scholarship, for re-

CAMBRIGG — The Irst Clerk Maxwell Scholarship, for re-search in Experimental Physics, has been awarded to W.

Mr. H. J. Mackinder, the Reader in Geography at Oxford, as
lecture for the Teachers' Training Syndicate on "The Teaching of Geography," on May 30.

The annual dinner of the Philosophical Society was held in

the Combination Room of St John's College on May 2, Prof. G Darwin in the chair

DUBLIN —Sir Robert Ball begins on Wednesday, the 13th inst, a course of lectures on "The Theory of Screws," in Trinity College, Dublin

SCIENTIFIC SERIALS

THE Quarterty Journal of Microscopical Science for March ontains—On a new species of Phymosoma, with a synopsis of the genus, and some account of its geographical distribution, by Arthur F Shipley (Plate xi) The new species, P weldon, was found by Prof Weldon at Bimmi Island, the Bahamas, it has no trace of hooks on the introvert ; there are two retractors. A synopsis of the twenty seven species now known is given, but seventeen species are described in Selenka's monograph on but seventeen species are cescribed in Scienka's monograph of the Sipaneulude. At to the geographical distribution, seventeen species are found in the Malay Archipelago, of which thriteen are endemic, five are found in the Red Ses, four in the Mauri tius, and three are found in the West Indies, but P. fourents is found only in the Hergen Fiord—On the British species of Crisia, by Sidney F. Harmer (Plate xii.). The author thinks that the ovicells furnish sausfactory specific characters; the that the ovicells turnish satisfactory specific characters; the aperture in the ovicell is sho an important character. Specific disgnoses of C deniculata, Link., C, chirman, Linn., C acuteata, Hasv., and C ramona, n. sp, are given. Notes are given of the habit of the Zoarium at different seasons, on are given of the habit of the Zoarum at different seasons, on the mode of branching, and on the breeding-times—The later larval development of Amphioxas, by Arthur Willey (Plate-stut-zv). The author again visited Messans, in the summer of 1890, to complete his studies on the development of the strial chamber of Amphioxas. As a possible explanation of the asymmetry of the larva, Willey thisles that it can be traced ultimately to the adaptive forward extensips of the notochord, being thus a purely ontogenetic prenomenen; the club shaped gland is shown to be a modified gill-slit.—On the structure of two new genera of earthworms belonging to the Eudrilder, and some remarks on Nemertodrilus, by Frank E. Beddard (Plates xvi.-xx). Hyperiodrilus ofricanus, n. gen. and vp., and Helio-drilus lagosenus, n. gen. and sp., found in a Ward case from Lagos, at Kew Gardens.

Thus only article of general interest in the Nuovo Giernale Bolanno Italiano for April 12 a note on the sigmatic disk of Vinca major, Ny By, M. Philotono, In the reports of the Italian Botaninal Society are short papers by Str. Baccamin on the secretory system of the Papillonanes; on the arrangement of herburg, by Stg. L. Micheletti; and others of special interest to Italian Botanina, by Stg. L. Micheletti; and others of special interest to Italian Botanina.

SOCIETIES AND ACADEMIES.

Royal Society, April 16 — "An Attempt to determine the Adiabatic Relations of Ethyl Oxide Part I. Gazeous Ether." By Prof. W. Ramsay, F R S, and E. P. Perman, B Sc.
The object of the research described in the memoir is the

The object of the research described in the memoir is the determination of the behaviour of ether in the state of gas approaching towards the state of liquid, when heat is communicated to it, so as to alter its condition adiabatically.

cated to it, so as to after its condition adiabatically.

Previous researches by one of the authors in conjunction with

Pr. Sydney Young have yielded data regarding the relations of

pressure, temperature, and volume of gaseous and of liquid

pressure, temperature, and volume of gaseous and of liquid ether from which the values of the isobanic and of the noshore differentials are obtanable. Such results lead directly to a knowledge of the differences between the specific heast at contant pressure and those at constant volume; and these differences are not constant, but vary with varying volume, pressure, and temperature

The meroor contains an account of experiments made to determine the ratio between the peach bests at constant persons and those at constant volume. The velocity of sound an gescous either was determined at various temperatures, pressures, and volumes; and by means of the lockbermal differentials, and the experimental results for the velocity of sound, the ratio between the two specific heats were calculated. From the difference and the ratio of the specific heats, the values of the specific heats.

The geteral conclusion is that, for any constant volume, the specific heat, whether at contain volume or at contain pressure, decreases to a limiting value with rise of temperature, and subsequently increases; and that the change with temperature is more rapid, the smaller the volume

At large volumes, the specific heats tend towards independence of temperature and volume, while at small volumes the influence of change of temperature and volume is very great.

The authors are at present investigating similar relations for liquid ether,

Zoological Society, April 21 — Prof. W. H. Flower, C. B., F. S., Perdieden, in the char — & communication was read from Leat Colonel Str. Oliver B. C. St. John, R. E., containing notes on a case of a Managone (*Ith patter immorphosphoreciling* containing notes on a case of a Managone (*Ith patter immorphosphoreciling* some remarks on a content of the containing of the containing notes on the containing of the containing of

May 1.—Suty-second Anniversary Meeting —Frof. Flower, F.R. S., President, in the chair—After the sudiors report had been read, and other preliminary business had been transacted, the been of the Council on the proceedings of the Society during report of the Council on the proceedings of the Society during 11 stated that the number of Fellows on January 1, 1891, was 124, being 4 less than the corresponding number in 1890 was 124, being 4 less than the corresponding Washers and the Corresponding Members had been elected to fill seasoness in those lists. In recognition of the effective protection accorded for sity years to the Great Stau, Sixtemarisms darrinafeaty) at two of in three British breeding stations—namely, in the Jaisad two of in three British breeding stations—namely, in the Jaisad with the Society of the Society and the same family, and in the Island of Foult by the late Dr. Socit, of Melby, and his son, Mr. Robert T. C. Socti—the Society And Society And

not quite cynal to thore of 1880, had exceeded those of 1886 by upwards of £1000, and might be deemed to be satisfactory. The wordinary expenditure for 1850 had been £123,48 of 1.14, which was £659 as £6 more than the corresponding amount for 1880, had were £123,48 of 1.14, which was £659 as £6 more than the corresponding amount for 1880, because the area removings argument of £259 to £15, 250. The balance brought up the total expenditure of the year to £25,572 tr. £6. The balance brought forward from 1880 was £1243 1; 114, and this, added to the motions received in 1890, give a total sum of this company of the continuery and the satisfactory of the total transport of the year to £25,72 tr. £6. The balance brought forward from 1880 was £1243 1; 114, and this, added to the motions received to the reduction of the mortion of the total sum of £1000 to the reduction of the mortion of the total sum of £1000 to the reduction of the mortion of the total sum of £1000 to the reduction of the mortion of the total sum of £1000 to the reduction of the mortion of the mortion of the total sum of £1000 to the reduction of the mortion of the total sum of £1000 to the reduction of the mortion of the total sum of £1000 to the reduction of the mortion of £1000 to the reduction of the reduction of £1000 to the reduction of the mortion of £1000 to the reduction of £1000 t tne work cone by British and foreign roologists during the year 1836, had been issued to the subscribers in December last, and had thus been published before the close of the year after that to which it relates. The library had been kept in good working order during the past year, and had been much frequented by order ourning the past year, and not occur much requestions, working goologists. A large number of accessions, both by gift and purchase, had been received and incorporated. In the Gardens to only new work carried out in 1890 had been the completion of the improvements of the Monkey House, but a large number of repairs and renewals of the different buildings in the Gardens had been made, and other minor improvements had been carried out. The number of visitors to the Gardens during the out The number of vintors to the Gardens during the year 1890 had been 64,0857, the corresp ording number in 1899 having been 644,597. The number of school children domitted free in 1890 was 13,935. The number of animals in the Society's collection on December 31 into was 255, of which offsy were mannial, 1273 birds, and 250 repeale Amongst the additions made during the past year, twelve were specially commented upon as of remarkable miners, and in most cast ergare mented upon as of remarkable interest, and in most cases repre-senting species set to the Society's collection of About 26 Gardens during the summer of 1890. The report concluded with a long list of the donors and their various donotions to the Menagerie during the past year—A vote of shakis to the Menagerie during the past year—A vote of shakis to the FR S, seconded by Mr A, I Socia, and carried unanimously —The report having been adopted, the meeting proceeded to circt the new Members of Connol and the onliners for the etect the new Members of Council and the others for the ensuing year. The usual ballot having been taken, it was announced that Mr. William T. Blanford, F. R. S., Dr. Albert Gunther, F. R. S., Mr. E. W. N. Holdaworth, Sir Albert K. Rollit, M. P., and Mr. Howard Saunders, had been elected into the Council in the place of the retiring members, and that Prof Flower, CB, FRS, had been re-elected President, Mr Charles Drummond, Treasurer, and Dr Philip Lutley Schater, FRS, Drummond, Treasurer, and Dr. Philip Lutley Solater, F. R.S., Secretary to the Soletiey for the ensuing year.—The remaining business having been concluded, the Fresident handed the silver medial of the Society to Mr. Thomas Edimondston, who attended to the part of Mr. Trans. Edimondston, of Dimest, and the part of Mr. Trans. Edimondston, of Dimest, the part of Mr. Trans. Edimondston, of Dimest, behalf of Mr. Robert T. C. Society of Melby, Shelland, in recognition of the effective protection accorded by them and their families repetitively to the Great Sizus as its breeding places in the Shelland in Section 1997. The proceedings terminated with the usual over of flushes to the Fresident.

Geological Society, April 22.—Dr. A. Gehle, F.R.S., Fresident, in the chart.—The following communications were read:—Results of an examination of the crystilline rocks of the General C. A. McMalion. The existion, in company with the Rev. E. Hill, spent a considerable part of last August in examing anew those sections in the Linard district which had proposed to the control of th

whose valuable contributions to the knowledge of the crystalline rocks of this district are well known. That the Lizard serpentines are altered peridotties may be regarded as settled, but doubts are ancrea periodities may be regarded as settled, but counts have been expressed as to their relation to other associated rocks, and as to the meaning of a streaky or banded structure exhibited by certain varieties. The authors, after re-examination of a large number of sections, feel no doubt of the accuracy of their original view that the peridolite was intruded into the hori-blende sobists and banded "granulitic" rocks, after these had blende schists and banded "granultic" rocks, after these had assumed their present condition. In it they find no signs of any marked pressure metamorphism, either prior or posterior to serpentinisation. They have failed to connect the streaky or banded structure with any foliation or possible pressure-structure. in the schists, and they can only explain it as a kind of fluxionstructure, viz as due to an imperfect blending of two magmas of slightly different chemical composition, anterior to the crystalliza-tion of the mass. The Porthalia sections have been examined with especial care, not only because the serpentine is nowhere so conspicuously handed, but also because its intrusive character has been denied, both it and the hornblende schists being ascribed to the alteration of a series of sedimentary rocks of suitable com-position. For this view the authors have failed to discover any evidence, and consider it contrary to stratigraphical and petro graphical facts. In regard to the genesis of the crystalline graphical facts. In regard to the genesis of the crystaltine schaus, which for purposes of reference were dwided by Prof. Bonney into a "ignatulitie," a "homblender," and a "intermediate of the professional profes sufficiently to allow of the two flowing for some little distance together, after which crystallization took place. In regard to the hornblende schots, the authors are not yet satisfied that either fluxion or mechanical crushing will account for every entiret motion or mechanical critisming will account for every production, the control of the co seice, the authors are doubtly whether it is any longer worth while separating it from the hornblende schuss. Of the igneous rocks newer than the serpentine, the gabbro has received the closest attention. It results in places (especially in the great dyke-like mass at Carrick Lur) a very remarkable foliation or even muneral banding, which has been claimed as a result of dynamo-metamorphism. The authors bring forward a number dynamo-metamorphism The authors bring forward a number of instances to establish the following conclusions:—(a) That this foliation occurs most markedly where the adjacent serpentine does not show the slightest sign of mechanical disturbance, rock, (c) that it sets in and out in a very irregular manner, (d) that when it was produced the rock was probably not a perfect fluid. Hence they explain it also as a kind of fluxion structure, produced by differential movements in a mass which consisted produced by differential movements in a mass which consisted of crystals of felaps and pyrosene, floating fluckly in a most or less viscous magna. The author's investigations tend to prove that (a) structure curvously similarity or distribution may be produced in fairly conselly crystalline rocks by fluxioned move-ments anterior to crystallization, and that (d) structures which of late years have been considered and the constraint of years more allies exclusively. This is productly the true evolution of a morphism subsequent to consolidation must have, in many cases, as like explanation. This is probably the true explanation of a large number of banded guesses which show no signs of crushing and holocytakiline, but in their more misuate structures differ from normal igneous rocks. The authors have seen onlying which has been favourable to the dead that pressure has artised the temperature of solid rocks sufficiently to soften them A discussion followed, in which Str. Teall, the Rev. E. Hill, Prof. Hull, the President, General McMahon, and Prof Bonney took part.—On a spherulitic and perlitic obsidian from Pllas, Jalisco, Meaco, by Frank Rutley.

Royal Microecopical Society, April 15.—Dr. R. Braith-waite, President, in the chair —Mr. T. Charters White presented three alides of sections of teeth permeated with collodion.—A letter from Mr. J. Aitkin, of Falkirk, was read, on a spot-mirror

NO. 112; VOL. 44]

method of illumination.—An abstract was read of a paper, by Surgeon V Gunson Thorpe, K.N., on some new and foreign Rottlera found on the West Coast of Africa, and belonging to the genera Trackesphere and Florusiaria.—Mr E. M. Neison exhibited two forms of bulli-eye condenser—one made like son exameters we obtained to business of the service consensarious was made like. Herechel's applianate, the other a new and simpler form, being made of two plane-convex lenses. This condenser seemed to asswer its purpose admirably, the amount of spherical aberration being only about one-fifth of that which existed in the old form—Mr. Nelson also reads some further notes on Distom structure. own also read some further notes on Diatom struc-tures as test-objects, which he illustrated by photographs— Mr C. Haughton Gill's additional note on the treatment of Diatoms was read, the subject being illustrated by photo-micro-graphs. Mr Mayall said the problem Mr Gill had endea-youred to solve was as to the existence or not of cellular structure in Diatoms estending through their substance, and he sought to demonstrate this by making chemical depositions which would probably fill up the cavities sufficiently to be distinguished by the microscope. Mr. Gill's observations were of great interest. because he had experimented with the definite ournose of testing because he had experimented with the definite purpose of westing a special point, thus applying to microscopy what Hershell would have termed an "experiment of inquiry"—a direct questioning of Nature on a point that had hitherto been regarded as almost beyond the sphere of experiment.

Academy of Sciences, April 27 – M. Ducharite in the character of Sciences, April 27 – M. Ducharite in the Market Science Scien upon cane sugar possesses etheric and anhydric properties, and is comparable in certain respects to the lactones -On the origin is comparable in certain respects to the lactiones — On the origin of pus cells and on the ide of these elements in inflamed tissues, by M L Ravier — On the performance of imanne engines and that of vcrew, and on a geometrical including calculating the first of these values without a dynamometer, if M. A Leden — — Mica as an invariable delectine, by M E. Bouty The anthor has previously shown that the capacities of mica condensers vary slightly with the duration of charging. He now finds that mica behaves again invariable dielectricing a direction normal to the planes of cleavage—that is, the capacity (e) of a lamina of useful surface (p) and thickness (e) is represented by the

formula $c = \frac{kp}{4\pi c}$, where k is a constant. It is remarked that the origin of the large variations of such condensers with duration of charging is the electrolysis of foreign substances contained in the superficial layers -On an alternate current motor, by MM Maurice Hutin and Maurice Leblanc -Quantitative studies on absorption, by M. G. Lemoine The action of light upon a mixture of oxalic acid and ferric chloride of various thicknesses a mixing of oxalic acid and terric chloride of various thicknesss and strengths is theoretically and experimentally determined— Effect of the presence of haldes of potassium upon the solubility of the neutral sulphate of potassium, by M. Ch. Blarer. Between 0° and 30° the solubility of K_pSO_1 in water is given in. parts per 100 by

$$O\theta = 8.5 + 0.12\theta.$$

On adding KCl, or other halide of potassium, at any definite temperature, the K₂SO₄ remaining in solution is given by the

K.SO. dissolved = a constant - the amount of K in added salt : for any temperature this becomes

 K_1SO_4 dissolved at $\theta^0 = 7.5 + 0.1417\theta - K$ of added salt.

atomic alcohol isomeric with the saccharoses, and very near to atomic alcohol isomeric with the succharones, and very near to malores at chemical constitution, it yielded glucace on inversion, and malores the chemical constitution, it yielded glucace on inversion, sequence solutions of texture and, by M. Algusan. The author arrives at the concision that texture, and skatts in agreeous solution is the state expressed by the formula $(C,H_0O_b)_b$ partially insociated according to a definite inw—Researchest upon the MS stantians Memore.—On the stomacher digestion of the $(C,H_0O_b)_b$ partially $(C,H_0O$ gean and stomachic pepsins transform coagulated albumin into syntonin, and afterwards into peptone, without passing through the pro pepsin stage; (3) that the predominance of the action the pro pepun stage; (3) that the predominance or the action of encophagean pepun on stomachic pepun in septemble the proposal pranties by the larger quantity of syntonin that it produces.—On the sexual evolution of the trouts of the Pyrenes, by M. A. Cannica. The metamere of the endodermous layer and of the primitive curculatory system in the post-branchia region of Vertebrata, by M. F. Houssay.—Contribution to the Eudy of the mechanism of urmary secretion, by M. O. Mad de Strickh. the mechanism of urmary secretion, by M. O. who der Strichi, P.—Respiesance duming winter of the starch in ligeous plants, by M. Emille Mer. The researches indicate that in ligeous plants such in sealouride at the end of the astumn, and generalized the sealouride at the seal of the subman, and generalized the sealouride of the sealour phylloxerous vines by carbon bisulphide mixed with vaselines, by M. P. Cazeneuve.

Retteerte

Academy of Sciences, February 7—M, F Plateau in the char —Micrographical researches on the nature and origin of phosphate rocks, by M. A. F. Renard The author gives the preliminary results of some researches on the formation of phosphate rocks. The investigation has been espocially directly the char —Micrographical researches on the nature and organ of phosphast rocks, by M. A. F. Renard The author gives the brophesta rocks, by M. A. F. Renard The author gives the brophest rocks by M. A. F. Renard The results of photophosphast rocks. The investigation has been committed of photophosphast rocks. The investigation has been sensitive of the policy of th

where A is a constant, F the tension of the saturated vapour at the temperature of the liquid, and V the velocity of the current,

Determination of the radius of curvature in nerallel coordinates, by M. Maurice d'Ocagne

March 7 —M. Plateau in the chair.—On a curious peculiarity of currents of water, and on one of the causes of sudden floods, by M. G. van der Mensbrugghe. An explanation is given of the fact that in a river the maximum velocity of the current does not occur at the surface, but about three-tenths of the depth not occur at the surface, but about three-tenths of the depth below the surface.—Reduction of nitrates by sunlight (second note), by M. Émile Laurent. The author has caused a beam of sunlight to fall upon solutions of nitrates placed in a vacum, and has found that after a certain time the space contained liberated oxygen, whilst the liquids possessed the characteristic reactions of nitrites. M. Laurent has analyzed the oxygen and nitrites, and finds that the quantity of gas is sensibly proportional nitrites, and note that the quantity of get is sensibly proportional to the nitrie formed. As might have been expected, the blue control to the nitrie formed of the congulation of the albumins of the service of cow's blood, by M.M. J. Corin and G. Ansaux. The author support the assertion made by Halliburton in 1883, that the albumin of serum ought not to be considered as a single subalbains of serum ought not to be considered as a single substance, but as insilter of two or three albamnouds, a, θ , and γ , coagulating respectively at temperatures— $\alpha = 73^\circ$ C, $\beta = 17^\circ$ C. The blood of man, the dogs $p_{ij} = 2\pi b t t_i$, $\delta c_{ij} = 2\pi b t_i$, δc forms of one and the same phenomenon occurring at the same temperature—On the curvature of poises with respect to a point on a curve of the *n*th order, by Frof C. Servan,—Darwey of a variable star, by M. Lee Ball. An account is covery of a variable star, by M. Lee Ball. An account is an extensive star of the star in the star in the star in the star in time the magnitude of the star increased from 5 7 to 8 The star in not unliched in Berninghoun field Sur Carlon S. 10 to 10 time the magnitude of the star increased from 5 7 to 8 The star in not unliched in Berninghoun field Sur Carlonge. M. de Ball's observations are only eye-estimations, and have not been made by the aid of a photometer. Further evidence of varia-bility is therefore required.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.
Lesses, Pamers of Control of Control

CONTENTS.	PAG
Fossil Insects By R. Lydekker	
Statistics of Population and Disease	•
Our Book Shelf:-	٠
Sonnenschein "The Best Books A Contributio towards Systematic Bibliography"	n
McPherson "The Fairyland Tales of Science"	
McPherson "The Fairyland Tales of Science".	
Letters to the Editor:-	
County Councils and Technical Education -Sir T. H.	
Parrer, Bart	
The Alpine Flora.—T. D. A. Cockerell, J. Inne Rogers	
Co adaptation,-Prof. R. Meldola, F R S.	•
Co adaptation.—Prof. R. Meldola, P. R. S.	
High and Low Level Meteorological Observatories.	-
Joseph John Murphy	
An "International Society."—Prof. W. H. Flower F.R.S.	
F.R.S.	
On some Points in the Early History of Astronomy	
II. (Illustrated.) By J. Norman Lockyer, F.R.S.	
Herts's Experiments, II	. 1
The Royal Society Selected Candidates	Ξí
The Endowment of Research in France	: i
Notes .	: i
The Institution of Mechanical Engineers .	: :
University and Educational Intelligence	
Scientific Serials	. 2
Societies and Academies	. 2
	2
Books, Pamphiers, and Serials Received	. 2

THURSDAY, MAY 14, 1891.

PRACTICAL GEOLOGY.

Aids in Practical Geology By Grenville A J Cole, F.G.S., Professor of Geology in the Royal College of Science for Ireland. (London. C. Griffin and Co, 1891.)

An Introduction to the Study of Petrology the Igneous Rocks. By Frederick H Hatch, Ph.D., F.G S (London. Sonnenschein and Co., 1891)

OWEVER prophetic may have been the far-seeing premonitions of men in advance of their age in the dim past, and however invaluable may have been the additions made to the superstructure since, it can scarcely be doubted that the foundation-stones of geology were laid by Scotchmen and Englishmen towards the end of the last, and during the earlier part of the present century. And what a charm is there about the story of these sturdy pioneers, not perhaps quite the men whom one would have picked out as most fitted or most likely to become the fathers of a new science. It has about it the elements of a genuine romance. For the early training of few of these men was such as to give a scientific bent to their mind, they did not have what we are pleased to call "the advantage of a scientific education". it is probable that they never spoke, perhaps never dreamed of, such a phrase as "the scientific method," which we are so fond of formularizing, and on which we plume ourselves somewhat. But in spite of these seeming drawbacks, rather perhaps because with these men genius was allowed to run its spontaneous untrammelled course. they opened out to mankind a domain of knowledge the very outskirts of which had been barely touched upon before. Of shrewd mother-wit were they, too keen of eve to be wrong about their facts: not a few were ardent sportsmen, and the same instinct which led them to ride straight to hounds or patiently and warily to stalk the deer, led them also, as they brushed away minor details, to go direct to main issues, and carried them on, without rest but without haste, through the toils of many a year's steady field-work. With what awe and reverence do we look up to these giants when, we pass their achievements ın review I

Nor does it one whit impair this feeling of respectful admiration to turn to the other side, and cast a glance at what were their unavoidable shortcomings. They were too hard-headed to be illogical in the matter of straightforward inferences, but it was hardly to be expected that they would escape going astray sometimes when they ventured on recondite speculation. Rough is not the word for their method: incomplete would be nearer the mark, but even that can scarcely be applied when the means at their disposal are taken into account. No one had yet taught the value of the microscope and balance to the geologist: and, when these and other instruments of precision were introduced, there was just a tendency to gird at appliances that had a finnicking look about them to Titans who had so long and so successfully relied on their hammers and their wits.

But by degrees it became clear in Germany, and later on in England, that, though the great main roads of the

newly-discovered territory had been tracked out with such brilliant success, methods more refined than had sufficed for pioneering work must be introduced if all the intricacies of its lanes and by-ways were to be explored Then the swing of the pendulum rather tended to bring about a disposition to exalt the new means of investigation, and there was just a risk that the sound basis of field-work might come to be undervalued if not neglected; and that Mineralogy and Petrology, instead of being the handmaids of Geology, might be thought to constitute the whole of that science. But the mischief never went far. The mantle which had fallen from the shoulders of the great fathers was not to be lightly cast aside: and, while every new aid was cordially welcomed, the conviction grew stronger and stronger that honest work in the field must for ever be the starting-point of geological inquiry

How thoroughly this truth has become engiained in the minds of geologists is seen directly we open Prof Cole's "Auls in Practical Geology." A large part of the book is taken up with minute and precise directions for carrying out the vanous kinds of microscopical, optical, and chemical examination of minerals and rocks. But on the first page we read—

"Such aids in determinative geology as are given in the following pages may be applied in any halting-place, or in cities after the return from an expedition; but, in any case, observations made on specimens are of slight importance if uncoupled with knowledge of their true position in the field."

And again-

"After a study of a number of type specimens, the student is recommended to go out to some well described district, and to endeavour to recognize the varieties of igneous and sedimentary rocks by careful observation in the field. In this ways alone can he appreciate the various modes of weathering, the massive or minutes structures due to jointing, the smooth or rugged outlines that characterize the masses of which his hand-specimens form a part.

Nothing short of striking the rock-mass in the rock-mass in the postton and surroundings, even to the broader features of the landscape, should content the geologist who would follow worthly the founders and masters of the science."

Again and again the author resterates the lesson-

"Just as no mountain mass can be described by a stranger from a number of hand-specimens, however beautiful, so no rock can be adequately described from isolated microscopic sections Again and again the observer will pass from his section to the solid specimen, and from this, in memory at any rate, to the great mass of which it formed a part."

And in dealing with the nomenclature of igneous rocks, the chaotic state of which is so largely due to the ignoring of their field-relations, it is insisted that—

"The following out of an igneous rock in the field is a most important lesson, and will soon determine what is valuable and what is valueless in any proposed scheme of classification."

That the author, in these and similar passages, is not speaking from hearsay, not merely re-echoing what is now a trusm, is shown by the admirable practical directions which he gives in the first chapter for the outfit and procedure of the field-geologist. Here, and indeed throughout the book, the instructions are detailed and precise

The author has not forgotten the time when he was a beginner, his early failures, and the disappointments of his student-days, when, from the neglect of some slight precaution, he failed to obtain the results he had been led to expect; and he has used every means in his power, by minute and specific instruction, to shield those who use his book from similar mishaps. As an instance, take what he says about the effect of acids on minerals. How often has the self-taught man turned wearily to one book after another on mineralogy, in the hope of getting some definite information on this point, and all he arrived at was the curt statement, "Soluble in acids," which each apparently had copied from its predecessor, or all had borrowed from some common source. What acid? Concentrated or dilute? Cold or hot? Quickly, or perhaps only after a fortnight's boiling? points he was left to make out for himself as best he could The happier pupil of Prof. Cole is treated far more liberally, and will not have to weary himself by feeling about in the dark if he attend to the cautions and instructions of the book now before us. directions for blowpipe-work are equally precise Only one who has been himself an actual worker would have told the observer to wait "till the first red glow has gone off" before noting the colour of a borax-bead. Of course, anyone would, sooner or later, find this out for himself. but, till he had found it out, he would probably blunder not a little, and anything that economizes time nowadays is not to be despised. There is no need to multiply instances; everyone who uses the book will find that it eminently deserves the epithet of "practical," which the author has assigned to it.

But are there no weak points on which the critic may exercise his function? Attention may perhaps be called to the following .- On p 6, a graphical method, due to Mr Dalton, is given for determining the full dip of a bed from the dips on two oblique sections. The writer may perhaps be pardoned for preferring a method of his own, given first in the Geological Magazine for 1876, p. 377. But, independently of any personal predilection, it may be said that the diagram in the case of this method is simpler than in that of Mr Dalton. This makes it easier to recollect, and, besides, the fewer lines there are in a graphical construction the less is the chance of error. In dealing with " streak," it would be well to notice that the true streak of some hard minerals. Iron-glance for instance, is not obtained till they have been rubbed down in an agate mortar.

Doubt is thrown on the value of Turner's test for the detection of bonn (p. 4): there is an article by Dr. C. Le Neve Fouter in the Mineralogical Magazine (vol. 1: p. 77) which should be consulted in this connection. It is hardly worth while enticing the nomenclature and classification of the crystalline rocks. No two petrographers are magreement here, and probably the exusing schemes of arrangement are all of about equal value There is fortunately no multiplication of species or introduction of new names. It might be possible to take objection to the description of Quarti-felist as compact form of Grante, for the part played by the quarts in the typ occles is totally different, and must be correlated with a difference in their mode of consolidating. Quarti-felist sets are specially common as dykes, and there may have

been facilities for the escape of water in their case up the fissures which they fill, that were not present in the case of the more thoroughly buried magma of Granite It was doubtless the presence of water in the granitemagma which kent the quartz fluid or plastic after the other minerals had crystallized; its escape in the case of Quartz-felsite may have led to the early crystallization of the quartz. In dealing with the foliated rocks, the author touches on the debated point of the "true schists." We are pretty well used to this phrase, and have waited long in the hopes of being told what constitutes a "true schist. but our patience has not yet met with the reward it ments. The author is of opinion that "the alleged distinction between schist-like rocks and schists of pre-Cambrian age requires great delicacy of definition." This is delicately put, and will command the assent of most geologists

The paleontological section will perhaps be looked upon somewhat demayely by those well versed in biology upon somewhat demayely by those well versed in biology. But it will serve its end, which is to enable those who cannot pretend to any large amount of biological knowledge to know the commoner fossils when they see them, and determine the genus to which they belong. The method may have a large element of "rule-of-thumb" about it, it may be called empirical, but in a large number of cases it is not practicable to attain to anything better. And it has a certain educational value, for it makes a student use his eyes even if it but slightly disciplines his reason.

That the work deserves its title, that it is full of "aids" and in the highest degree "practical" will be the verdict of all who use it.

Nor will Dr Hatch's handy volume be any less welcome Those who wish to have in a compact form the prominent characters of the rock-forming minerals and the igneous rocks, will find all the information needed by a student concisely and lucidly put forth Some slight acquantance with crystallography and the optical properties of minerals is assumed. A short section on these subjects would have made the book more self-contained, and need not shave increased its size very materially

The igneous rocks are defined to be "those that have been formed by the consolidation of molten material." There is a spice of danger in the word "molten," for it may lead to the belief that the fluidity of the material was the result of "dry heat" in the case of a Laccolite the view so generally held is atken, that the overlying beds have been bent up by the intrusion of a molten mass. It is, to say the least, quite as likely that earth-movement caused a differential amount of bending in two adjoining beds, and that, as an empty space was thus gradually formed between the two, the molten matter was driven into it.

On the subject of the classification of the igneous rocks we find the following healthy expression of opinion.

"The various types are so mtimately related, that any attempt at rigid and systematic classification is not likely to meet with any great measure of success." Certainly not till some sounder basis of classification than any yet suggested is hit upon In the meantime Dr. Hatch's grouping is one that from its clearness and simplicity will be a real boon to the student.

A most useful feature in the book is the list of localities

where each rock occurs. The illustrations are very well executed. Though the book has appeared only recently, one teacher at least can already bear testimony, founded on actual experience, as to its value to students.

A. H. GREEN

BACTERIOLOGY.

Les Virus. Par Dr. S. Arloing (Paris: Ancienne Librairie, Germer, Baillière, et Cie., 1891)

THE name of Dr. S. Arloing as the author of a work on bacteriology is a sufficient guarantee that the book is worth reading, nor are we disappointed. "Les Virus" is one of the best volumes on this science yet produced. It is not a mere complation of other men's work, giving a categorical account of the numerous pathogenic and non-pathogenic bacteria now recognized,

Virus "is one of the best volumes on this science yet produced. It is not a mere complation of other men's work, giving a categorical account of the numerous pathogenic and non-pathogenic bacteria now recognized, but is a thorough scientific investigation into the principles of no of the most important branches of medical science, and might perhaps be better called a manual of "microbiology".

The work is divided into six parts, under the following heads .-

- (1) General considerations as to the nature of the bacterial poison
- (2) Form and mode of life of the microbes (biology)
 (3) The part taken by the microbes in the propagation
- and spread of infectious diseases.

 (4) Struggle of the host against the poison Natural
- extinction and artificial destruction of its effects
 (5) Immunity enjoyed by the body against certain
- microbes.

 (6) Attenuation and reproduction of the bacterial

It will be seen by the above list that this work covers a large field, and one not exactly dealt with by any previous author.

In the first part, which is subdivided into six chapters, Dr. Arloing commences with an historical survey of the science of bacteriology, pointing out the gradual extension of ideas from the time of Rhazes, who, in the ninth century, attributed small-pox to a process of fermentation "comparable to that which takes place in the juice of the grape when made into wine"; touching then on the works of Rayer, Davaine, Chaveau, and others, the author traces the development of the science until present times and the discoveries of Koch and Pasteur. An interesting comparison of the "virulent" parasites with simple parasites, such as Trichina spiralis, then follows; and, next, the formulation of two statements which form the basis of the modern science (1) the active agents of the virulent process are organisms; (2) these organisms are living, and possess specific properties.

The second part of the work deals with the biology of bacters. The methods of cultivating them are fully described, and, what we do not remember to have seen in any other work on bacteriology, there is a full account of the effect on micro-organisms of nourshment, temperature, light, atmospheric conditions, and electricity. In this part, also, are two most important chapters—namely, the effects on the microbes of the nature of the cultivating medium. This is only just beginning to be properly us-

derstood, and its investigation has already been productive of valuable results

The chapter on the products of the growth of microorganisms is hardly up to the general excellence of the work. It has not been sufficiently brought up to date, so that the researches of Dr. Hankin, and the more complete investigations of Dr. Sidney Martin in reference to the albiumnoses and alkaloids, do not appear in it. The disastess and promaines are, however, fully discussed, and much may be learnt from a previal of this chapter

The third division of the book is devoted to the ride which the microbes play in the propagation and causation of disease. The chapter on contagion is one of the best in the book, and would alone form a most valuable brockure. After a consideration of the general modes in which contagion is carried, a most exhaustive account is given of air, water, soil, food, and antificial inoculation (vaccination) as carriers of disease. As a natural sequence, the modes of entry of the germs into the body are then described, auto-infection being included, and next we have a consideration of what may become of the organisms after their entry, and the changes which take place in the host. The descriptions here given are exceedingly precise, and, although rather condensed, convey all that can be desired.

Passing now to the fourth part, we find four chapters devoted to the strife between the host and the microbes, and the natural extinction and artificial destruction of the posson. In the third chapter the subject of disnifiction is noticed, both by heat and antiseptics, special attention being drawn to the necessity of the careful disnification of sputum, linen, bedding, &c.,—points which cannot be too strongly insisted upon in all hospitals, and not merely in those devoted to fevers or diseases of the chest.

The fifth part deals with the very difficult, and, at present, vague subject of "immunity" Dr Arloing dimunity into two classes—"acquired" and "natural" On this subject no one is more qualified to speak than the author of this work, for he has made it almost a special study for years, and it is treated of in his usual masterly way.

The sixth and last part contains some of the more recent researches (especially those of Pasteur) on the attenuation of the virus.

Taking the work as a whole, we cannot speak too highly of it. We heartly congratulate the author on the success of his labours. The book is well illustrated, and we cordially recommend it to all those who wish to study a subject so replete with interest and of such vital importance to mankind.

Fil. W.

OUR BOOK SHELF.

Anleitung zur Bearbeitung meteorologischer Beobacktungen fur die Klimatologie. Von Dr. Hugo Meyer. (Berlin: Julius Springer, 1891)

WERR this little book less severely technical in form, it might be commended to the notice of that large class of observers whose sole aim and object in meteorological registration is to ascertain the characteristics of the local climate and to compare them in detail with those shown by the similar records of other places. It teaches how the results of observation may be tabulated or graphically

represented in the forms most approved by climatologists, and discusses with much precision the meaning of different kinds of mean values ; though, indeed, it omits all mention of the geometric mean, the application of which in climatology was lately under discussion in the Royal Meteorotology was lately under discussion in the Royal meterological Society. But it is, we fear, hardly elementary enough to meet the requirements of beginners and amateurs, especially such as regard a formula of any complexity with something of that distant respect that they accord to holy mysteries; and on the other hand it aims at nothing beyond the formal and statistical presentment of facts, and never deviates into the seductive, if sometimes illusive, field of physical causation. It is what its title proclaims it to be, a guide to the working out of meteorological observations for the purposes of climatology—the chimatology, that is to say, of the temperate cone. For those who work in a more extended field, some of the author's methods and dictates may be found to need modification. His schedule may be found to need modification. Its scneouse of the sual hours of observation makes no mention of those most frequently observed in the tropics, and his uncompromising condemnation of the use of Lambert's formulæ in reducing wind-registers, however justifiable in the case of the variable winds of these latitudes, ignores that of countries where tradewinds or monsoons blow steadily for weeks or months together with but little deviation from the normal quarter, together with but fittle deviation from the hormal quater, and where the direction undergoes a regular oscillation daily. In working out this daily oscillation at such places, the use of Lambert's formula is not only justified but almost indispensable.

Within the somewhat narrow limits that Dr. Meyer has prescribed to himself, he has executed his task carefully and conscientiously, but in this country, at least, his merits are likely to be appreciated by only a small class; chiefly, indeed, by that estimable few who find in plodding labour its own sufficient reward. The student wno is encoved with some snare or scientific imagina-tion, who loves to trace the inner workings of Nature, and sees in diagrams and tabulated statistics only means to this end, will find Dr. Meyer's work a somewhat dry study; and when he shall have mastered its contents, should he ever be challenged by Arthur Clough's "Questioning Spirit," and asked.

"What will avail the knowledge thou hast sought?"

he must answer as he best may from his own mental resources. His author, at least, will not help him to a reply.

Intensity Coils how made and how used. By "Dyer" Sixteenth Edition (London: Perken, Son, and Rayment)

In this book a simple and interesting account is given of galvanic batteries, induced electricity, and the methods of making and using intensity coils, which include numerous experiments that may be described briefly as "popular." In the present edition many other branches of the subject have been touched upon, including electric lighting, elec-tric bells, electric telegraph, electric motors; and a few words are said on the telephone, microphone, and phono-graph. Although the book is not presented as a scientific treatise, but simply as a guide containing the necessary instructions for making and using the above-named instruments, yet by its means many may be led to make a more advanced study of the subject, which to-day is of such high importance

General Physiology. By Camilo Calleja, M D. (London: Kegan Paul, Trench, Trubner and Co., Limited, 1890.) THE author of this book means by the word "physology "discourse of nature"; and his intention is to denote by it "the study of positive science in the abstract denote by it "the study of positive science in the abstract expressed the mission of allowing the subject to drop because senies." The scheme he has set before himself is solong [1] considered that the discussion had arrived at a stage what.

less than " to comprehend under the fundamental principle of mechanism—conservation of energy—all the laws and theories concerning nature." In order to show the spirit in which he sets about the accomplishment of his task, it may perhaps be enough to say that he regards the planets as "bodies constituted of organic and inorganic matter," and that to him living organic matter seems "the proximate agent of planetary movements, for which non-living bodies are only the cosmic medium."

The sun, we learn, is not "a body in combustion." but "principally a great reflecting mass, which, situated in the focus of the orbits of many planets, reflects their the rocus of the orbits of many planets, reflects their infra-luminous emissions, these producing light by their conglomeration." As for "natural light or daylight," it is "a photohermic radiation produced by transference, not only of the radiating motion of the planets, but also of the motion engendered by solar living beings." If anyone is attracted by writing of this kind, he will find plenty of it in Dr. Calleja's amusing volume.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions ex-pressed by his correspondents. Nisther can he undertake to return, or to correspond with the votiets of, especial manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

Co-adaptation.

It sometimes appears to me that the neo-Darwinians must speak a language of their own, because they are so fond of telling me, in a stereotyped phrase, that, "if words have any meaning," such and such words have expressed some meaning which no such and such words have expressed some meaning which no ordinary grammatical construction can extract. The present is a good case in point Prof Meldola says that he finds "a remarkable discrepancy" between my two previous letters on the above subject, and seeks to reveal it by quoting from the first letter, thus -

""I do not . . hold myself responsible for enunciating M Herbert Spencer's argument, which the quotation sets forth, merely reproduced it from him as an argument which appear to me valid on the side of "use-inheritance". For not only d hold myself responsible for enunciating Mr For not only did Darwin himself invoke the aid of such inheritance in regard to this identical case, . . '&c If words have any meaning, this identical case, . '&c If words have any meaning, this implies that Dr Romanes agrees with Darwin in regarding this case as one in which 'use-inheritance' played a part."

Does it? When a man says that in his opinion a certain argument in favour of a certain conclusion is valid, is this argument in favour of a certain conclusion is valid, is this equivalent to his asying that he accept the conclusion? And when he adds, lwice over, that he purposely abstains from expensing any opinion of his own with regard to the conclusion, is this equivalent to his saying the precise opposite? The tast of the case is unpily as follows. Mr. of Meddoin reproduced "it, "white the case is unpily as follows. Mr. Spencer's conclusion," I write to show that this particular argument was stayled. But the three was another argument.

reproduced Mr. Wallace's argument against Mr. Specier's deficience of "use-sinebraneae." I wrote to show that the partial deficience of "use-sinebraneae" involve to show that the partial control of the production of the state of the state

those who were interested in the matter would be able to form those who were interested in the matter would be able to form their own oplinon as to the value of the arguments adduced on either side of the question. I very much regret to find, how-ever, that Dr Romanes—whose amount of spare time appears to be most enviably inexhaustible—still_finds it necessary to prolong the correspondence. I am compelled, therefore, to enter the field once more, II only for the purpose of presenting my own case in its true light. What Dr. Romane's position may own case in its true light. What Dr. Romane's position may each of his contributions to the sulpet, that I am not the first who has lost has way in attempting to thread the masse of this writer's productions. As fer as I am concerned it will suffice to say that munication. In the review of Mr Pascoc's hook, from which this discussion originated, I did not merely reproduce: Wh. Wallace's argument against Mr. Spencer's idefence of "me inheritance." prolong the correspondence. I am compelled, therefore, to enter phasizing the importance of the factor of superimposed I pointed out that large numbers of cases of co-adaptation might be thus accounted for, and I used Mr Spencer's own illustration by way of example In summing up his own conclusion, parts by variation and natural selection appears to me, therefore, to be a wholly imaginary difficulty which has no place whatever in the operations of Nature" ("Darwinsm," p 418) Not only, therefore, has Dr Romanes misrepresented my view, but he has gone further. The other "argument on the same side" referred to in the above communication is this very denial of co-adaptation as a fact in Nature. This, with most amazing sanglested, is now claimed by my correspondent, who speaks of it as "the one which I had stated"! I must leave it to others to decide what value can be attached to the statements of a writer who adopts the principle of appropriating an argument, and pitting it forward in a manner which would lead most readers to consider that he had been the first to elaborate it simply because he has expressed the same idea in abstract ols instead of in concrete terms.

symnois instead of in concrete terms.

The next phase in the discussion is the admission by Dr Romanes that Mr Wallace's conclusion is correct, i.e. that co-adaptation is non-existent "As it appears to me, from his puly, that Prof Meldola's views on the subject of 'co-adaptation'. that Prof. Meddolfs view on the subject of 'co-adaptation', are really the same as my own, I rist once more in order to point out the deatity" (NATURE, vol. slin; p. 583) Mr. Romane did most, therefore, than imply point out that we were spread that this was "the only argument which could be were spread that this was "the only argument which could be a supported to the same of at any rate it appears to be intelligible among themselves, it and yellow the conveys their views with respect to the conveys the conveys their views with respect to the conveys the only from the circumstance that they have been enabled to

Physiological Selection and the Different Meanings given to the Term "Infertility.

In the discussion concerning the segregation of varieties occupying the same region, and the influence of physiological selection in securing this result, it is necessary that we consider selection in securing this result, it is necessary that we consider the different meanings given to some of the terms by different writers. The general fact on which Dr. Romanes insisted, in his paper on "Physiological Selection," was compatibility in the reproductive system of some, and incompatibility in that of others belonging to the same species On p 360 of his paper we read that "racial incompatibility," "however produced," "is the primary condition required for the development of varie-ties into species" Infertility and sterility are also used by him as ties into species — intertuity and sternity are also used by non-acquivalents for incompatibility in the reproductive system. Thus, on p 400 we find the statement that "All natural varieties which have not been otherwise prevented from Intercrossing, and which have been allowed to survive long enough to develop any differences worth mentioning, are now found to be protected from intercosing by the bar of sterlity—that is, by a previous change in the reproductive vystem of the kind which my theory

requires "

Dr Romanes did not attempt to catalogue the different forms of discriminative incompatibility that are included in the incompatibilities of the reproductive systems of different races, but reference was made to three forms (1) to compatibility in the reference was mane to ince forms (1) to compatibility in the time of flowering in those of the same race, as contrasted with incompatibility in those of different races, as on pp. 352 and 356, (2) to greater numerical fertility when the male and female elements of the same race unite, than when those of different elements of the same race unite, than when those of different mess unite, as in the note on p 354, and (3) to numerical in-fertulty through deficient production by hybrids, as on p 36, and p 357 in the note, and in the suggested experiments on an it the comparative "digrees of fertility" to be noted. To hote forms which were mentioned, we may add, as coming under the entergory of physiological incompatibilities, (4) lack of square in hybrids; (5) lack of adaptation in hybrids; (6) lack of excape from competition with kindred in hybrids; and (7) the vaperor energy and promptizes with which the male and female superior energy and promptness with which the make and temale clements until in pure unions, as contrasted with cross unions. Dr Romanes probably refers to this principle when he speaks of sternity as "failure to blend" (p. 565. It is last, when associated with the free distribution of the fertilizing clements, ensures the segregation (that is, the dis-

cruninative isolation) of two or more varieties occupying the eraminate robustion) of two or more varieties occupying the same area and propagating during the same season, and there-fore seems to me the most important of the forms of physio-logical segregation. This segregative principle, which I call potential or prepotential segregation, must, in almost every case, he operative between species and varieties that continue distinct while indiscriminately mingled on the same area and while fertilized by elements freely and indiscriminately distributed during the same season, for no other principle is able to secure during the same season, for no other principle is ance to secure free propagation and at the same time to prevent crossing under such conditions. Seasonal segregation is here excluded, and the other forms of physiological segregation when acting under such conditions are of little avail in preventing swamping unless curried to the extreme, and they then involve a waste of from one-half to the whole of the germs of the less numerous variety;

ofte-halt to the whole of the germs of the less numerous wartely; for the most favoursable case passible is when two vartetes occupy the area in equal numbers, and such cases rarely exit, expectally in the initial history of species.

Though aumerical infertility and tardy potency are readily distinguished, complete imposence and complete numerical sterility are more likely to be confyunded, for the complete incapacity of the unite and female elements of different varieties. for uniting involves failure to produce hybrids, as complete as or untime involves matter to produce ayonics, as computes when the elements untte without producing living offspring or germinating seed. The great difference is that in the case of cross impotence the geim remains unaffected by the alien fertilizing element, and therefore ready to be fertilized by any fertilizing element of its own kind that may reach it, while in the case of simple numerical cross sterility (if there be any such the case of sample numerical cross sterility it there be any such case; the shear elements promptly units, and therefore leave no case; the shear elements promptly units, and therefore leave no kindred fertilizing elements. Cross impotence, with prepotence of pure susons when associated with the free distribution of the fertilizing elements, produces positive segregation; for, when characterizing varieties occupying the same area, it canares the propagation of each with its own kind while preventing crossing; but suserned infectility of first crosses produces what I call but mannered infectility of first crosses produces what I call be provided to the produce of the produce of the produce of the preservation of datanct varieties the awapting effects of any crossing that takes place, and is therefore of great importance and the preservation of datanct varieties and species whose the post-four forms of hybrid inferiority mentioned above are also forms of negative eggregation, and, though of the highest importance when co-operating with prepotential aggregation or suprober principally of the preserving datanct varieties or species, when us-assisted by any degree of positive segregation.

We are sone prepared to see how the different meaning of facilities.

fertility have occasioned more or less misunderstanding in the discussion of physiological selection and its effects. Romanes, the seven forms of segregation above-mentioned are all forms of infertility between races, and therefore are all causes of commants, the seven forms of segregation stoyes-mentioned are all proposed and the companion of the companio

to limit the meaning of infertility between more to numerical in-entitility of first crosset, and then assumes that this is the only incompatibility that is included under physiological selection, and the property be attributed to this promotion. He effect that Before closing I wish to ruse the question whether a high degree of selective numerical fertility between races is not always associated with some degree of selective potential fer-titity. Or, using infertility in the more restricted meaning given tility. Or, using infertility in the more restricted meaning given in my nomendative, is not a high degree of segregate fecundity and cross infertility always associated with some degree of segregate two forms of loneomistibility are usually, if not always, associated in the segregation of species, is in not probable that they are smally associated in the segregation of varieties? Again, as we know that segregate prepotence, when associated with the free distribution of the fertilining elements, well produce prepotential segregation of the fertilining elements, well produce prepotential segregations. tion, effectually preventing crossing, without impairing powers of survival, and as there are many cases in which the continued survey, and as there are many cases in which the continued segregation of warieties occupying the same area is due entirely segregation of warieties occupying the same area is due entirely weakened forms of the principle associated with other forms of incompatibility in the reproductive system, and still other numerous cases in which partial isolation (produced by a slight diversily of habits, or by the occupation of adjoining distributions). would be speedily broken down except for these physiological incompatibilities, are we not fully warranted in the assertion that physiological selection is an essential factor in the evolution of many species?

to hypersonces. Security of the control of the form of segregation having been recognized, the question naturally arises as to what have been recognized, the question naturally arises as to what have been the causes through which the incompatibility has ceased to be entired on the ducussion of this point, I have given the uncertaintien to it. I think I have accorded in showing: (1) that any portion of a species subject to temporary isolation, through the compatibility of the property of the consistency of the compatibilities of the property owing to the constitution of reflex selection, by which the mutual fortuity and other compatibilities of an intergenerating stock are kept in force (see PATURE, vol. Am. pp. 26 and 569); (2) that partially incommittee the consistency of the property of the consistency of the consist ool., vol xxiii. pp 312-322). 26 Concession, Osaka, Japan.

Propulsion of Silk by Spiders.

Tropussion of SMR by Species.

The subnor ("O. P. C") of the stride on "Arachide", in the "Encyclopedia Britannica, "says the stride on "Arachide", the string of the species of the speci thinks, that (from microscopic anatomical investigations which thinks, that (from microscopic anatomical investigations would be has himself made) there is good evidence of spiders having the power to expel it; for he finds a certain muscular arrangement which would apparently suffice to give this power, and observers have actually seen the lines propelled."

Owing to the doubt herein expressed, may I ask your inser-tion of a chance observation lately made by me upon a splder, which has convinced me of the truth of the theory that spiders

tion or a chance observation lately made by me upon a splicin, which has convinced me of the truth of the theory that splicing do expel their lines at will, and this, too, as secondary to one of the control of the co who both witnessed with me, and at the same instant of time, the sudden appearance of the new line.

the sudden appearance of the new line.

With each successive trial, I was able to substantiate and
improve my observation; at first the appearance of the line
seemed instantaneous, as to its whole length; next I was able
to detect its elongation of itself after about 2 feet of its length

to detect its elongation of itself after about 3 feet of 18s length was visible, then I could see at leaving the spinnerts, and finally, during the last moment of its travel, I could perceive very distinctly that it drew the spider algabily floward.

From these premises I can but infer that the vision contained by the silic-glands, which, at the ordinary slow rate of eminsion, turns to goussmer immediately upon its exposure to the air, when expelled as now, woolenly, remains vanced sufficiently

an, when expelled as now, volcenly, remains viscid sufficiently long to reach a certain distance.

These secondary threads, carried towards the colling by the diplot, were a sevent brought down again when the felt to the diplot of the diplo

was coose to ner all ine time, and indeed the only object appar-ently which was close enough, the only hit me the first lime, when perhaps she had heard my approach; thus may strengthen the remarks made by Mr. C. V. Boys in your number for November 13, 1800, where he says: ". sight, as we understand the term, in spate of their numerous eyes, seems to

St. Beuno's College, St Asaph, N W., April 27.

The Crowing of the Jungle Cock.

I THINK there can be little doubt that Mr. H. O. Forbes has

I TRINK there can be little doubt that Mr. H. O. Forteen has fallen unto the same missake as 1 had, in regard to Mr. Bart-leaf a statement that "none of the known may be the same that the same took."

At fair I took that to mean that the jumple cook do not crow at all, and was collecting notes from sporting men here, to supplement my own at years: experience, when yours of February 5 arrived, and by it I see that Mr. Bartlett implies that the crows no to full, look, and long, as that of our barn-leaf the process not to full, look, and long, as that of our barn-leaf the process not to full, look, and long, as that of our barn-leaf the process not to full, look, and long, as that of our barn-leaf the process of the same that the crows not to full, look, and long, as that of our barn-leaf the process of the same that the crows not to full, look, and long, as that of our barn-leaf the same that the crows not the same that the same that the crow door cock

CHAS. A. CARUS-WILSON.

Mr. Forbes exactly gives the difference, as thinner, more Air. Forces exactly gives the difference, as thinner, more wiry, and high pitched; it is also shorter, at least in the wild G. ferruguna. These I have often heard crowing, and shot in

G. Jerruguau. These I have often heard crowing, and shot in the extreme east of Asam, where for a very large area, on the UTA in the continue of the Continue

But the difference between the wild G. ferrugina and our "barn-door" cock, in this particular, is so well marked that it could invariably be detected

"Dath-odor" cock, in tuny particular, it is owen unarset uses, and in the particular to the particular

only. Sibsagar, Asam, March 27.

Antipathy [?] of Birds for Colour

WITH regard to the destruction of the yellow crocus by the Sparrow, mentioned by your correspondent "M H. M" in NATURE, vol. xlin p 558, this bird appears to have a pre-dilection for yellow. In an article on "Birds' Nests and Nestdilection for yellow. In an article on "sires Nests and rest-building," in the Annual World, present number, an instance is given of sparrows using the flowers of the laburium for hier nest. Only lately 1 have been watching them picking out they ellow centres of the daisy, but in this case it roas for food, and I am inclined to believe that some portion of the crocas is also eaten. At this time of the year they are well known to be partial to buds and flowers of different kinds—for instance, the blossoms of the gooseberry bushes

Doubtless, the bright yellow colour attracts the attention of this now much censured bird, so omnivorous in his tastes and such a general scavenger, and therefore not wholly to be condemned. Clevedon, April 28.

The Destruction of Fish by Frost.

REFERRING to Prof. Bonney's letter in NATURE, vol xlin. P. 295, regarding the destruction of fish by frost, and in which he asks for information from more northern latitudes, I may say that during the water of 1885-86, at Cape Prince of Wales, Hadson's Stratt, when the thickness of ice in a small lake was being measured, live fish were often seen; and upon the last occasion, when the ice measured six feet and half an inch, several were thrown up with the water that, upon our cutting through, imwere throwney mediately overflowed. These fish were about an inch and a neumediately overflowed. These fish were about an inch and a were extremely lively. I may add that during the summer both feeder and outlet of the lake averaged about eight summer both feeder and outlet of the lake averaged about eight to the proof feet in its deepest part. The inches in depth and the lake nine feet in its deepest part ches in thickness, covered the lake F. F. PAYNE inches in thickness, covered the lake Meteorological Service of Canada, Toronto, April 16

The Plying to Pieces of a Whirling Ring

WITH reference to the recent discussion in your columns on the whirling of steel bands, the following results will be of

interest. A weldless steel flask, with spherical body 12 inches in diameter and 8 inch thick, constructed for use in a centrifugation of the spherical forms of the spherical forms of the spherical flash of velocity.

At 16,000 revolutions per minute the body of the flask had

NO. 1124, VOL. 447

bulged 2 inches in diameter, this is equivalent to an extension of 17 per cent. of the circumference, the peripheral speed being 840 feet per second, and the tension 31 5 tons per square inch.
The experiment was not continued, as it was considered sufficiently satisfactory, and the bulged flask is kept as a curiosity.

McGill University, Montreal.

HERTZ'S EXPERIMENTS!

I N the last article the principles upon which a rapidly vibrating electric oscillator should be constructed were considered, and how the sudden break-down of the arr gap enabled these rapid vibrations to be started. It is probable that this break-down occurs in a time smaller than the thousand millionth of a second How very rapid interatomic motions must be !

Consider now the principles on which an apparatus is to be constructed to receive the vibrations produced by this oscillator. We may observe in the first place that as we are dealing with a succession of impulses at equal intervals of time we can utilize resonance to accumulate the effect of a single impulse Resonance is used in an immense variety of circumstances to accumulate the effect of a series of impulses, and is avoided in another immense variety of circumstances to prevent accumulating sounds, to keep clocks and watches going, to work telegraphs By avoiding it carriages drive safely over rough roads, ships navigate the seas, the tides do not now overwhelm the land, the earth and planets preserve their courses round the sun, and the solar system is saved from destruction Resonance may be thus described ~ If a system is able to vibrate by itself in any way, and if we give it a series of impulses, each tending to increase the vibration, the effect will be cumulative, and the vibration will increase. To do this the impulses must be well timed, at intervals the same as the period of vibration of the system itself. Otherwise some of the impulses will tend to stop the vibration, and only some to increase it. and on the whole the effect will be small. In order to use resonance in the construction of the detector of waves of electric force, we must make our detector so as to be capable of an electric vibration of the same period as the generator of the waves If we do this we may expect the currents produced in it to be increased by each wave, and thus the electrification at its ends to increase, and so increase the chance of our being able to produce a visible spark. Two ways of using a detector have been mentioned. One is to observe the heating of a conductor by the current in it, and the other to observe a spark due to the electrification at the end of the conductor. The latter is the most sensitive and has been most frequently employed, and is the method first employed by Hertz Two forms of detector may be used for observing sparks One form consists of a single conductor bent into a circle with its two extremities very close together. An electric charge can oscillate from one end of this to the other round the circle and back again. If the circle be the proper size, about 70 cm. in diameter for the large sized oscillator and about 5 cm. in diameter for the smaller sized one described in the last article, the period of oscillation of this charge will be the same as that of the charge on the generator of the waves, and its oscillation will be increased by resonance until, if the each of the circular wire be close by resonance until, it the ends of the circular wire be close enough together, the opposite electrification of the ends will become great enough to cause a spark across the gap. The other form of detector depends on using two conductors, each of which has the same period of electric oscillation as the oscillations we wish to detect.

Continued from p. 14.

are placed in such a position that an end of one is near are piaced in such a position that an end of our is are that end of the other which will at any time be oppositely electrified. For example, if the electric force in our waves be in vertical lines, then if we place two elongated conductors, one vertically above the other and separated by a very small air space, the electric force alternating up and down will cause currents to run up and down the conductors simultaneously, and the upper ends of both will be similarly electrified at any instant, while the lower end of the upper one will always be oppositely electrified to the upper end of the lower conductor, and if these two points, or two short wires connected with them, be close enough together, a spark will pass from one to the other whenever the electric force sets up these electric oscillations in the conductor. Thus this apparatus is a detector of the electric force. Whenever there is a spark we may be sure that there is electric force, and whenever we cannot get a spark we may be sure that there is either no electric force or anyway too little to produce sparks.

The apparatus will be more sensitive for electric forces. that oscillate at the same rate as the natural vibration of the electric charge on the conductor, because the effect of each impulse will then add to that of the last; resonance will help to make the electrifications great, and so there will be a better chance of our being able to produce a spark. We may weaken the strength of this air gap by reducing the pressure of the air in it. To do this the ends of the conductors, or wiles connected with them, must lead into an exhausted air vessel, such as a Geissler's There is no doubt that much longer sparks may thus be produced, but they are so dim and diffused that when dealing with very minute quantities of electricity those sparks in a vacuum are not more easily seen than the smaller and intenser sparks in air at atmospheric The additional complication and difficulty of manipulation from having the terminals in a vacuum are not compensated for by any advantages. This whole detecting apparatus works on somewhat the same principle as a resonator of definite size connected with one's ear when used to detect a feeble note of the same pitch as the resonator Such a resonator might very well be used to find out where this note existed and where it did not. It would detect where there were compressions and rarefactions of the air producing currents of air into and out of your ear. In the same way the conductor sparking tells where there are alternating electric forces making currents alternately up and down the conductor, and ultimately electrifying the end enough to make it spark. In the sound resonator there is nothing exactly like this last phenomenon. We have much more delicate ways of detecting the currents of air than by making them break anything. If anybody would allow the electric currents from a Herizian detector to be led directly into the retina of his eye, it would probably be a very delicate way of observing, though even in this direct application of the current to an organ of sense it is possible that these very rapidly alternating currents might fail to produce any sensible effect, for they are not rapid enough to pro-duce the photochemical effects by which we see.

To recapitulate the arrangements proposed in order to detect whether electric force is propagated with a finite velocity, and if possible to measure it if finite. It is proposed to create electric oscillations of very great rapidity, oscillating some four or five bundred million times per second, and it is expected thereby to produce waves of electric force whose length will be less than a metre of electric force whose length will be less than a metre if they are propagated with the velocity of light. It is proposed to do this by causing an electric charge to oscillate backwards and forwards between two con-ductors, and across an air gap between them. This oscillating charge is to be started by charging the conductors, one positively and the other negatively, until they discharge by a spark across this air gap By making the conductors small, and the distance the

charge has to go from one to the other small, the rate of oscillation of the charge can be made as great as we require If waves are produced by this arrange-ment, we can reflect them at the surface of a large conducting sheet, and then loops and nodes will be produced where the incident and reflected waves co-exist. The loops will be places where the alternating electric forces are great, while at the nodes there will be no electric forces at all In order to detect where there are these alternating electric forces and where there are none, it is proposed to use either a single wire bent nearly into a circle, with a very minute air gap between its ends, or else two conductors placed end to end, with a minute air gap between their ends In either case, if the natural period of vibration of a charge on the single conductor, or on each of the conductors in the second arrangement, is the same as the rate of alternation of the electric force we wish to detect, there may be sufficient electrification of the neighbouring ends to cause a spark across the minute air gap We are thus in possession of a complete apparatus for determining whether electric waves are produced, and what their wave-length is

The experiment is conducted as follows .-The two conductors which are to generate the waves are placed, say, one above the other, so that the electric are placed, say, one above the other, so that the electric charge will run up and down in a vertical line across the spark gap between them. They might be placed horizontally or in any other line, but for definiteness of description it is well to suppose some definite position. We may call them A and B. They are terminated in polished knobs, between which the spark passes. A and in are connected with the terminated of hardward and the spark passes. or a Wimshurst or other apparatus by which a succession of sparks may be conveniently made to pass from A to Before the spark passes, A and B are being electrified, and when the spark occurs the electricity on A rushes over to B, and part of it charges B, while the electricity on B rushes across the spark, and partly charges A, this taking place alternately up and down. Each time there is less electricity, for some is neutralized during each oscillation by the opposite charge; for energy is being spent, some in overcoming the resistance of the spark gap, i.e. in producing the heat developed there, and some in producing electric waves in the surrounding medium. Thus the electric energy of the two oppositely charged bodies A and B is gradually dissipated, and one way of describing this is to say that the two opposite electric charges combine and neutralize one another. This whole language of talking of electric charges on bodies, and electric currents from one to the other, of electric charges neutralizing one another, and so forth, is not in accordance with the most recent developments of not in accordance with the most recent developments or electro-magnetic theory. At the same time, those for whom these articles are written are familiar with this language, and with the rivew of the subject that it is framed to suit, while they are unfamiliar with effectively and electrically and magnetically strained and threeby the sext of electric and magnetic energy, and consequently it would have added very much to their difficulty in grasping the details of a complicated question if it had been described in unfamiliar terms, and from an unfamiliar point of view.

The electric force in the neighbourhood of the vertical generator will lie in vertical planes through it, and as A and B are alternately positive and negative, the electric force will alternately be from above downwards, and from below upwards. If, then, this force is propagated outwards in a series of waves, we may expect that all round our generator waves of electric force will be diverging; waves in which the force will be alternately down and up. The state of affairs might be roughly illustrated by elastic strings stretched out in every direction from our generator. If their ends at the generator be moved alternately down and up, waves will be propagated along the strings, waves of alternate motion down and up

In order to reflect these waves, we require a metallic sheet of considerable area some two or three wave-lengths away from the generator; so far away in order that we may have room for our detector to find the loops and nodes formed every half wave-length where the outgoing waves meet those reflected from the screen Not too far away, or our waves will be too feeble even at the loops to affect our detector. The waves are thrown off all round, but are most intense in the horizontal plane through the spark, so that our detector had better be placed as near to this plane as possible. The detector may be either a very nearly closed circle of wire, or two may be either a very nearly closed circle or wire, or two conductors, each somewhat longer and thinner than the combined lengths of the generating conductors, and placed vertically over one another, and separated by a minute air gap As the theory of this latter form of detector is simpler than that of the circle, it will simplify matters to consider it alone. The two conductors should each have a period of electrical oscillation up and down it, the same as that of the charges on the generator. The generator consists of two conductors certainly, but then during the time the spark lasts they are virtually one conductor, being connected by the snark across which the electric charges are rushing alternately up and down. Hence the period of oscillation of the charges on the generator corresponds to that on a single conductor of the same size as its two parts combined. Various exof the same size as is two parts combined. Various experiments have been made as to the best form for these conductors that form the detector. They might be made identical with the generator, only that the spark gap in the generator should be represented by a connecting wire They may be longer and thinner. If longer, they should be thinner, or they will not have the same period of manual of the whole, the best results have been got admiration. On the whole, the best results have been got with conductors somewhat longer and thinner than the generator. It is not generally convenient that the spark between the two conductors that form the detector should take place directly from one to the other It is not easy to make arrangements by which distance apart of these conductors can be regulated sufficiently accurately most convenient way is to connect the lower end of the upper conductor and the upper end of the lower one each with a short thin wire leading one to a fixed small knob, and the other to a very fine screw impinging on the knob. The screw may then be used to adjust the spark gap between it and the small knob with great acspark gap netween it and the small know with great ac-duracy. This spark gap must be very small indeed, if control to the spark gap must be well with the spark gap which is a spark gap. The minute sparks that are formed sparks gap when doing delicate work are too faint to the spark gap when doing delicate work are too faint to the spark gap when doing delicate work are too faint to the spark gap when doing delicate work are to faint to the spark gap when doing delicate work are to faint to the spark gap with the spark g Having placed the detector in position between the generator and the screen, the difficult part of the observation begins. It is heartrending work at first. A bright vation origins. It is neartrenuing work at Irist. Addignt spark now and then arouses hope, and long periods of darkness crush it again. The knobs of the generator require repoilshing; the spark gap of the detector gets closed up; dust destroys all working; and not without much patience can the art be attained of making sure of getting sparks whenever the conditions are favourable, or getting sparks whenever the conditions are favournote, though it is easy enough not to get sparks when the conditions are unfavourable. Before making any measurements, all this practice must be gone through. It is hard enough with the success of others before us to encourage us, with their advice to lead us, with a clear knowledge of what is to be expected to guide us. How much credit, then, is due to Hertz, who groped his way to these wonderful experiments from step to step, without the success of others to encourage him, without the advice of others to lead him, without any certainty as to what was to be expected to guide him. Patiently, carefully, through many by-paths, with constant watchulness, and checking every

advance by repeated and varied experiments, Hertz worked up to the grand simplicity of the fundamental experiment in electricity that is engaging our attention

Having gained command over the apparatus, we may look about for places where sparks occur easily, and for others where they cannot be produced Two or three places may be found where no snarks can be observed places inay be found where no spaces.

These places will be found to be nearly equidistant.

The distance in search of The distance They are the nodes we are in search of They are the nodes we are in search of The distance between any pair is half the distance an electric wave is propagated during the period of an oscillation. Their presence proves that the electric force is not propagated instantaneously, but takes time to get from place to place If the electric force were propagated instantaneously, there might be one place where the action of the currents induced in our reflecting sheet neutralized the direct action of our generator; but there could not be a series of two or more such places between the generator and the reflecting sheet. That there are more than one proves that electric force is propagated from place to place, and does not occur simultaneously everywhere. It sets the crowning stone on Maxwell's theory that electric force is crowning stone on Maxwell's theory that electric force is due to a medium. Without a medium there can be no propagation from place to place in time. It only remains to confirm by calculation that the rate of propagation is the same as that of light. This is a complicated matter in the same as that of light. This is a complicated matter in which is the question of how fast should, on the propagation is the same as that of light. theory, the charge oscillate up and down to the problem has only been accurately solved in a few special cases, such as that of a sphere by itself. conductors that have been employed are not this shape, are not by themselves, and so only rough approximations are possible as to the rate at which these oscillations occur. Knowing the wave-length will not determine the velocity of propagation unless we know the period of vibration , and consequently this direct measure of the velocity has only been roughly made, but it agrees as accurately as could be expected with Maxwell's theory that it must be the same as the velocity of light if electrical phenomena are due to the same medium as hight The conviction that more accurate determinations will confirm this agreement is founded upon safe ground It was pointed out that the ether that transmits light It was pointed out that the ether that transmits ingit and is set in vibration by the molecules of matter can hardly avoid moving them itself. This ether can hardly help having other properties than merely transmitting a comparatively small range of vibrations. It can hardly help producing other phenomena. When it has been shown that, if there is a medium concerned in constitution. veying electric and magnetic actions, it must possess properties which would enable it to transmit waves like light, and when it has been shown that there is a medium concerned in conveying electric and magnetic actions, and that the rate at which they are conveyed is approximately the same as the rate at which light is propagated, the conclusion is almost unavoidable that we are dealing with the same medium in both cases, and that future ex-periments, capable of accurate calculation and observation, will confirm the conclusion that electric force is tion, will confirm the conclusion that electric force is propagated through, and by means of, the luminiferous ether with the velocity of light. We really know very little about the nature of a wave of light. We know as great dead more about electric and magnetic forces, and much may be learnt as to the nature of a wave of light much may be learnt as to the nature of a wave of light much may be searnt as to the nature of a wave of sight by studying it under the form of a wave of electric force The waves produced by the Hertian generator may be a metra long or more. The difficulty is to get them short enough. We know a good deal about how they are pro-duced, and from this, and also by means of suitable de-duced, and from this, and also by means of suitable detectors, we can study a great deal about their structure.

They are truly very long waves of light. Atoms are
Hertzian generators whose period of vibration is hundreds of millions of millions per second. A Hertzian generator may vibrate rapidly, but it is miserably slow compared

with atoms. And yet the wonder is that atoms vibrate with atoms. And yet the wonder to the souls in so slowly. If a Herizian generator were, say, 10⁻⁷ cm. long, about the size of a good big atom, its period of vibration would be some hundreds of times too rapid to produce ordinary light. Atoms are probably complicated Hertzian generators. By making a comcomplicated afterizing generators. By making a com-plicated shape, as, for example, a Leyden jar, a small object may have a slow period of vibration. All that is required is that the capacity and self-induction may be large in comparison with the size of the con-ductor. We saw that these rapidly vibrating generators have but httle energy in them: they rapidly give out their energy to the ether near them. This is also the case with atoms. These, when free to radiate, give up their energy with wonderful rapidity. How short a time a flash of lightning lasts! It is hardly there but it is How short a time gone the heated air molecules have so suddenly radiated off their energy. The reason why atoms in the air, for instance, do not radiate away their energy like this is because all their neighbours are sending them waves Each molecule is a generator, but it is a detector as well. It is kept vibrating by its neighbours: it occupies a part of the ether that is in continual vibration, and so the atom itself vibrates. As each atom can radiate so rapidly, it must be a good detector : its own vibrations must be very much controlled by the neighbourhood it finds itself in; and as the waves of light are very long compared with the distances apart of molecules, those in any neigh-bourhood are probably, independently of their motions to and fro, each vibrating in the same way It is interesting to calculate how much of the energy in the air is in the form of vibrations of the ether between the molecules of air. A rough calculation shows that in air at the ordinary density and temperature only a minute fraction of the total energy in a cubic centimetre is in the ether; but when we deal with high temperatures, such as exist in lightning-flashes and near the sun, and with very small densities, there may be more energy in the ether than in the matter within each cubic centimetre All this shows how wide reaching are the results of Heriz's experiments. They teach us the nature of waves of light. We can learn much by considering how the waves are generated. Let us consider what goes on near the generator, consistcet us consider what goes on near the generacy consains of two conductors, A and B, sparking into one another. Before each spark, and while A and B are being comparatively slowly what is called charged with electricity, the ether around and between them is being strained. The lines of strain are the familiar tubes of electric force. If A be positive, these tubes diverge from all points of A, and most from the knob between it and B, and converge on B Where they are narrow, the ether is much strained; where wide, the ether is but little strained. Each tube must be looked upon as a tube of unit strain. The nature of the strain of the ether is of unit strain. The finance of the strain of the control of the original of the mature of the strain being unknown. We do not know the nature of the change in a piece of .rdia-rubber when it is strained, nor indeed in any solid, and though the ether is much sampler in structure than india-rubber, it can hardly be wondered at that we have not yet discovered its structure, for it is only within the present century that the existence of the ether was demonstrated while men have known solids and studied their properties and structure for thousands of years. Any way, there is no doubt that the ether is strained in these tubes of force when A and B are oppositely charged, and that the energy per cubic centimetre of unstrained ether is less than that of strained ether, and that the work done in man that of strained enter, and that the work done in what is called charging A and B is really done in strain-ing the ether all returned them. When the air gap breaky down, and an electric spark takes its place, there is quite a new series of phenomena produced. Suddenly, the strained ether relieves itself, and, in doing so, sets up new

motions in itself. The strained state was probably a peculiar state of motion, and in changing back to ordinary ether a new and quite distinct state of motion is set up. This new state of motion all round the conductors is most intense near the spark, and is usually described as an electric current in the conductors and across the spark, or as a rushing of the electric charge from one conductor to the other. The electric current is accompanied by magnetic force in circles round it, and the tubes of magnetic force define the nature of the new movement of simplicity, the existence of this magnetic force has been unnoticed It is due to a peculiar motion in the ether all round what are called electric currents. The current in fact consists of little else than a line, all round which this movement is going on; like the movement surrounding an electrified body, but also unlike it. Whenever electric forces are changing, or electrical bodies moving, or electric currents running, there this other peculiar motion exists. We have every reason for thinking that this, which may be called the magnetic strain in the ether, as the movement all round electrified bodies the ether, as the invenient all round electric strain only exists in these three cases. (1) when the electric strain only exists in these three cases. (1) when the electric surain is changing, (2) when electric currents are running. These three may be all cases of one action Certainly the magnetic strain that accompanies each is the same, and it seems most likely that the electric change is only another aspect of the magnetic strain. There are analogies to this in the motion of matter that partly help and partly annoy, because they partly agree and partly will not agree with the etherial phenomena. Take the case described in a former article of a chain transmitting waves. Attention was drawn to the displacement of a link and to its rotation. Now for the analogy: to seem at all satisfactory the first thing that would strike one would be to pay attention to two motions, to the velocity of displacement of the link and to its rotation. This would lead to interminable difficulties in carrying out the analogy. We cannot liken electric strain to a velocity in this direct and simple way, because, what are we to do with a change in the strain which produces the same effects as a continuous current? A change in the strain is all very well, it would be like a change in the velocity, but what about a continuous change in the velocity; we can hardly suppose a velocity continually increasing for ever we are evidently landed in immediate difficulties. It is better therefore to be content to liken the electric strain to a displacement of the chain link. It seems most likely that it really is a peculiar motion in the ether, but we must be content for the present with the analogy. If we want to drive it further, we must suppose stress in the chain that draws the link back to be due to a motion in the chain or of things fastened to it, and then the changed motions protungs rastened to it, and then the changed motions produced by a displacement of the chain might be analogous to the peculiar motions accompanying electric strain. It would lead us too far to work out this analogy. Returning to the simpler case of the displacement of the link representing electric strain, and the velocity of its rotation representing magnetic strain, see how the actions near a Hertrian generator may be likened to what takes place Hertisan generator may be likened to what takes place when a wave is being sent along a chain. While the conductors are being slowly charged we must suppose becture strain to be produced in all the surrounding space. This is a comparatively slow action, and as the rate of propagation is very rapid, the electric strain will rise. practically simultaneously in the whole neighbourhood, and that it does so is a niost important fact to be taken account of in all our deductions from these experiments.

This slow charging must be represented by a slow raising of one end of the chain, which raises the rest of it to a great distance apparently simultaneously if the raising be done slowly. Suddenly the air gap breaks. This might

be represented by lifting the chain with a weak thread, and by having the end of the chain fastened to a pretty strong spring. When the thread broke the spring strong spring. When the thread broke the spring would pull the chain back quickly, would pass its position of equilibrium, and thus commence a series of rapid vibrations on each side of this position the vibrations would gradually die away owing to the energy of the spring being gradually spent, partly on friction in itself, and partly in sending waves along the chain. In actually performing the experiment, an india-rubber tube or limp thin rope is better than a chain when hung horizontally, as the chain is so heavy; when it can be hung vertically, a chain does very well. In the description it simplifies matters to describe a chain, because it is easier to talk of a link than of a bit of the rope, a link has an individuality that identifies it, while a bit of the rope is so indefinite that it is not so easy to keep in mind any particular bit Consider now what keep in mind any particular bit Consider now what these waves are, what sort of motion originates them When the spring first starts, the near parts of the chain move first. What happens to any link? One end of it moves down before the other. What sort of motion, then, has the link? I must be rotating. Thus it is that change in the displacement is generally accompanied by rotation of the links Thus it is that change in electric strain is accompanied by magnetic strain. The analogy goes farther than this. Each wave thrown off may be goes farther than this. Each wave thrown off may be described as a wave of displaced or as a wave of rotating links, and the most displaced are at any time the most rapidly rotating links. Just in the same way, what have hitherto been called waves of electric force may also be looked upon as waves of magnetic force Because there are two aspects in which the motion of the chain may be viewed does not diminish from the essential unity of character of the wave-motion in its waves, and similarly the fact that these Hertzian waves have an electric and a magnetic aspect does not diminish from the essential unity of character of the wave-motion in them. At the same time the two elements, the displacement of a link and the rotation of a link, are quite distinct things; either might exist without the other, it is only in wave propagation that they essentially co-exist. In the same way electric strain and magnetic strain are quite different things; though in wave-motion, and indeed whenever energy is transmitted from one place to another by means of the ether, they essentially co-exist.

FIVE YEARS' PULSE CURVES.

OVER five years ago it occurred to me that there would be considerable interest in keeping a systematic record for some time of the rate of pulsation, ret of the number of beast (per minute) of the pulse. I therefore commenced the practice by taking, every night, an observation of my own pulse; these observations, originally undertaken solely for my own personal interest, have been considered to the consideration of the present considerable to the considerable of the five present country to the considerable of the five years, that I thought it might be interesting to readers of NATURE to have these results put before them.

First, then, as to the method adopted in these observavations. I count the pulse bears for one minute 'avery night' before returns to bed, and invariably while in a standing posture. From the records thus obtained the average for each month is deduced in the usual way, vizby adding together all the numbers for the month, and dividing by the number of days on which observations were taken. With regard to this important consideration

Thus avoiding the considerable error that is introduced by counting for, say. Afteen seconds only, and multiplying.

The time has wated from s 3 o clock to z o'clock

NO. 1124, VOL. 44]

is of the number of observations, since an insufficiency thereof would, of course, greatly vitiate the value of my curves—I may state that during the first four years I omitted to take an observation on only seventeen nights altogether. During the fifth year, I find twenty-one ob-servations missed. Nevertheless, the net data from which the curves are deduced are not quite so abundant which the curves are deduced are not quite so adminished his statement would imply; for, in calculating the monthly average, I have invariably struck out altogether all readings above 79. My reason for this procedure was simply that I wished to obtain a curve showing the normal pulsations; now, anything much above 75 is abnormally high (especially in my own individual instance, for it will be noticed that my pulse is below the usual average of 70), and I can nearly always assign a distinct cause, such as the feverishness caused by a cold, or excitement, or recent exercise; it therefore appeared to me fairest to knock out altogether the results of such disturbing causes, and since for this purpose an arbitrary line must be drawn somewhere, I decided to draw it at 79. On the other hand, bowever, I have retained all the 79. On the other nand, nowever, I have retained an tare other readings, no matter how low they might be, although the "fifties" are very common, and occasionally even the "forties" have been touched. It might, perhap, be thought that these very low readings should be neglected equally with the very high, but such a course appeared to me altogether illegimate, both because such low readings. seemed, judging from their occurrence, to be, so to speak, normally caused, and unassignable to any distinct extra-ordinary cause known to myself, and also because I should hardly have known where to draw a minimum line However, I now regret that the readings below 50, at any rate, were not rejected; but such readings are so extremely rare that they cannot have much influenced the curves. In order that the reader may judge for himself on what data these curves are founded, I have appended a table showing the net number of readings from which each monthly average was drawn, and have also stated (in brackets) the number of readings below 60 included in each month.

On the control of the

On examining the monthly curse, it is at once obvious that there is a strong similarity between the five years, clearly every year the curve falls through the spring, until about mediumner, and then rises wonderfully steadily assembly a strong the strong of the strong



(except that of the winter irregularity, 1889-90), I could assign a fairly plausible explanation. For instance, during the summer of 1886 I was under medical treatduring the summer of 1800 I was under incurcal treat-ment in July of 1800 I was touring among the Swiss mountains: while at the end of February 1887 I had removed from a low-lying northern suburb, to a rather higher southern one; this change might with some

pausishity be considered as the possible disturbing cause in the 1898 paring circus. Nevertheless, looking at the results as a whole, I was not satisfied with the curves: it appeared to me as by no means improbable that the monthly average was calculated on a rather too short perrod, thus allowing temporary disturbing causes to manifest themselves unduly, it therefore determined to try the effect of advantages. therefore determined to try the effect of calculating the averages on a two-monthly period, throwing into one total January and February, March and April, May and June, July and August, September and October, November and December respectively. On drawing the curves corresponding to these averages (thick-lined curve), I was delighted to find order and symmetry completely regnant : all the aberrations have of course disappeared, and order is supreme. This two-monthly curve clearly shows a single maximum in winter, followed by a fall to the minimum at midsummer, and then by a rise to the winter maximum

It is evident that the curves for all five years are very closely similar, though by no means identical in nature, but I am especially anxious to point out the extraordinary symmetry displayed by the curves on either side of a maximum or minimum point. For instance, the curves for the following periods,

1886 July-October, ,, April-December, ,, November-February 1887, 1888 November-May 1889, 1889 The whole year,

are wonderfully symmetrical, in some cases even being almost geometrically exact

What, however, may be the exact interpretation of these curves I must leave it to those better acquainted than myself with physiology to decide; but it is worth noting that these curves are exactly contrary to the statement in Michael Foster's text-book, that the pulse

is said to rise in summer 3 The following is the table above referred to as showing the net data for each month, and also (in brackets) the number of readings below 60 included in each case :-

1886.	1 1888.
January 28	January 25 (1)
February 19	February 23 (1)
March 21	March 24 (3)
April 25	April 30 (4)
May 30 (1)	May 30 (11)
June 29	June 30 (11)
July 30 (1)	July 31 (10)
August 28 (8)	August 28 (9)
September 20 (2)	September 28 (5)
October 29 (1)	October 31 (5)
November 25	November 26 (2)
December 23	December 28 (3)
1887	1889
January 28 (2)	January 25
February 26 (1)	February 23 (2)
March 30 (3)	March 31 (9)
April 27 (4)	April 28 (8)
May 27 (3)	May 28 (3)
June 25 (5)	
July 31 (3)	July 28 (4)
July 31 (3) August 30 (6)	August 28 (7)
September 28 (2)	September 27 (A)
October 30 (2)	October 30 (2)
November 23	November 26 (4)
December 25 (2)	December 25 (1)

		890.
lanuary	27 (5))	July 24 (2)
February	24 (5)	August 30 (8)
March	28 (4)	September 29 (7)
April	28 (7)	September 29 (7) October 24 (5)
May	27 (7) . 26 (8)	November 22 (I)
Tune	26 (8)	December 30

If these numbers be compared with the curves, it will be found that in a rough way they agree with them; the diminishing number of these low readings every autumn. no less than their increase towards the summer, being obviously correlated with the rise and fall of the curves. F. H. PERRY COSTE.

THE SCIENCE MUSEUM AND GALLERY OF

VIGOROUS protests continue to be made against the appropriation, for the new Gallery of British Art, of the site which ought to be used, as originally intended, for the Science Museum. Several letters on the subject by men of high authority have been printed in the Times, and on Tuesday a deputation, which could not but command attention and respect, waited upon Lord Cranbrook and Mr Goschen to represent to them the opinions held by all who are in a position to form a trustworthy judg-ment on the question The Government are still en-gaged in considering the matter, and it is to be hoped that they are receiving and giving heed to the counsel of their natural advisers, although, unfortunately, this is a priori extremely doubtful

We print the letters addressed to the Times by Sir F Bramwell, Mr. Poynter, and Sir J Coode, and an account of the proceedings of the deputation on Tuesday

It has for many years been recognized that the science collections at South Kensington are housed in a manner which largely diminishes their value for their principal use—viz. that in connection with the Royal Normal School of Science

This school, as every one knows, is, as regards its main building, situated on the east side of Exhibition Road, while the West Gallery adjacent to Queen's Gate

West Gallery adjacent to Queen's Gate
1a 1885 the Government appointed an inter-departmental
committee to consider the subject and to report, and they
charman of the committee. The committee fively not elssentienty reported in the sense that so the land lying west of
Exhibition Road, and between that road and Queen's Gate, suitable buildings should be certed according to a complete design,
but that they should be carried out in successive portions.

Nothing was done on this report.

In 1889 another committee was appointed; this committee made very similar recommendations, and last year the Govern-

ment acquired further land.

There are now on the west side of Exhibition Road, and immediately opposite the science schools, the observatories used by Mr. Norman Lockeer, and also a newly-creeted physical

aboratory.

Everything seemed to be, after all these years of walting, in train for affording the needed accommodation, when, incredible as it must appear, the Chancellor of the Exchequer announced that the whole of this well-considered and satisfactory strangethat the whole of this well-considered and satusfactory arrange-ment is to be given up. He stated it had been determined to sweep away the observationes and the physical laboratory, as the state of the state of the state of the state of the schools, and to devote the particular plot of ground to a picture gallery. I look upon this as a most disastrous proceeding, and one that, in the interest of the great National Department at the state of the state of the state of the state of the Asy one who will take the panes to wint the ground, or even to look at an accurate plan of it, will see that there is plenty of good space available for the picture gallery without interfering the state of the publisher at where proposed is no thoroughly prescuence as that,

with the needs or the science collection, and that the notion of building it where proposed is so thoroughly preposterous that, as our American friends say, it must have originated in "pure cuseofness." FREDERICK BRAMWELL. No. 5 Great George Street, Westminister, May 9.

NO. 1124, VOL. 44]

SIR FREDERICK IDAMWALL in his letter of this morning points out the disastrous effect on the interests of the national from the intrastance of the result of the national from the intrastance of the saw Callery of Britath Art, to be planted precisely on the spot where it will cause the greatest amount of incoordenience. To an artist a still more flagrant matance of "pure cussedness" in this matter would appear to be that the building should be placed where it can have no commeetion with the existing galleries, when there is a piece of ground higher up the road in immediate connection with them

The galleries on the east and west of the Horticultural

ground againer upon etc. on in minematic coloration with melin Grardena, which were built for pictures at the time when there was a scheme for bioding annual international exhibitions, are whether by a happy "falled" or by careful calculation on the part of their constructor, General Scott, without doubt the best of their constructor, General Scott, without doubt the best of their constructor, General Scott, without doubt the best seer been constructed in Baginal SS in Frederick Lengthon has, I know, expressed this opinion, and every artist who exhibited in these galleres during the three or four years that the skilled in the search of th

Art
Why these huidings, acknowledged to be as good as they can
be, and actually ready on the spot, should not be used for this
presently according to the control of the spot of the spot
presently according to the spot of the spot of the spot
presently according to the spot of the spot
presently according to the spot now housed, thus affording provision for the extension of the collection, which is growing annually by the addition of the pictures purchased under the Chantrey bequest, and to which pictures purchased under the Chantrey occuest, and to which it is certain that further considerable additions will constantly be made by gift and bequest as yoon as there is a place in which they can be properly and permanently exhibited Also, there is for once, if advantage be taken of it, an oppor-

tunity for carrying out a reasonable and consistent scheme for both science and art. EDWARD I POYNTLE, R A

28 Albert Gate, S W , May 11.

HAVING served on the Committee on Machinery and Inven-tions in connection with the Science and Art Department of the Committee of Council on Education, I desire most emphatically to endorse the protest of Sir Frederick Bramwell which appears in your columns of this day's date.

Although the fees received from patentees up to the end of

1885 exceeded the expenditure of the Patent Office by upwards of 2 millions sterling, nothing practically has been done to put the Patent Museum and Museum of Machinery and Inventions

in an efficient condition.

ear after year the Committee, of which I am a member, has Year alter year the Committee, of which I am a member, has urged that more space should be given to the authorities at South Kenangton, and now, when it was thought the recommendations were about to be realized, it is asserted that the promued site is to the givent of the proposed of the proposed of the to the givent of the proposed of the proposed of I takerely trust that this intension may not be carried out, but that the site in question, which exactly faces the Royal College of Science, will be appropriated for the science collections, to

of Science, will be appropriate which purpose it has long been assigned JNO, COODE, President

The Institution of Civil Engineers, 25 Great George Street,
Westminster, May 11.

The deputation which waited upon Lord Cranbrook, the Lord President of the Council, and Mr Goschen was large and representative Mr. Plunket, Mr., First Commissioner of Works, was also present Among the deputation were: Sir William Thomson (President of the deputation were is it william I admissin (President of the Royal Society), Sir Berhard Samuelson, M.P., Sir George Gabriel Stokes (Past President of the Royal Society), Mr. C. Acland, M.P., Sir Frederick Bramwell, F.R.Se Breef, Story-Maskelyne, M.P., Sir Douglas Galton, C.B., Mr. Poynter, R.A., Prof. Unwin, Mr. Francis Galton, Prof. Ayrton, Prof. Flower, C B., Prof. Armstrong (Secretary of the Chemical Society), and Mr. Fletcher and Mr. Woodward, of the British Museum.

Prof. Story-Maskelyne, in introducing the deputation, in the absence of Sir Henry Roscoe (who is laid up with influenza), said it embraced a body of gentlemen distinguished not so much said it swhraced a hody of gentlemen distinguished not so midd by their numbers as by their character, representing as they did the Royal Society and the scientific mean of England. They by their numbers as they can be sufficiently as the scientific mean of England. They was the scientific mean of England. They who were deeply concerned in what he might call the new University which had mean for science at South Kensiquon foll the place now society of the scientific mean would have to go across the road to get to sanother and interesting branch of the National Science Collection and interesting branch of the National Science Collection and interesting branch of the National Science Collection of the Science of the Science Collection of believed that the Government would have to sak Parliament to supplement the grant of ASO, coo given by the anonymose donor. What he asked was that they should not be told off-hand that the scheme could not be elizered, but that they should be allowed to take the sense of Parliament as to whether the site was to be occupied in the way proposed or not. They objected to the money being simply asked from Parliament and the control taken out of its hands.

The Chancellor of the Exchequer —You may entirely exclude at. That will not be done. We shall take such precautions that. That will not be done. We shall take such precautions by trustees and by contracts that such a contingency will not

occur.

Prof. Story-Maskelyne said has was very glid to hear that. Sir William Thousson, on behalf of the Royal Society, and Sir William Thousson, on behalf of the Royal Society, and the second state of the Royal Society, and the second seco galleries in the world

gaueries in the world

The Chancellor of the Exchequer—Can you tell us—for I
have not yet been able to make it out—in what way the proposed arrangement would be fatal to the work of the College of
Science?

Sir William Thomson .- By cutting the school in two-by separating the school from the place in which the instruments

are kept.

The Chancellor of the Exchequer.—You mean that it is too

far to walk? Sir William Thomson,-It would be dreadfully risky to have

Sir whilm I norson.—It would be dreadnilly risky to have corry about delicate instruments.

Sir Bernhard Samuelson, as a member of a departmental committee which considered the question of housing the College of Science, supported Sir William Thomson's views, and pointed at that already there had been as necroachment upon the land which had been acquired for the purposes of the Science Museum

Moseum.
The Chancellor of the Exchequer.—It was purchased for The Chancellor of the Exchequer.—It was purchased for the Chancellor of the Mose of the chancelor of the Exchequer, after the assumance which he Chancellor of the Exchequer, after the assumance which he Chancellor of the Exchequer, after the assumance which he chancelor of the Exchequer, after the assumance which he man that, if there should be an expansion of the est gallery, owner one would be ready to extend the manifemence of the present donor.

present donor.

The Chancellor of the Exchequer.—I think that that is rather a matter for our grandchildren. I think there is plenty of space to fill with worthy pictures for a very long time to come.

Prof. Story-Maskelyne.—But £80,000 will not do it.

NO. 1124, VOL. 447

Sir B. Samuelson said he hoped the question of the site would Sit B. Samuelson said he hoped the question of the site would be reconsidered, and that those representing science should have the assurance that ample space would be given them not only for their present requirements but also for the extension which appeared to be looming in the future. The Chancellor of the Exchequer.—I am anxious to provide well for science. We hope to bring science into one centre fronting the Impernal Institute.

fronting the Imperial Institute, Sir B. Samuelono said that if they were given an area equal to the amount purchased last year for the purpose of science alone they only, in his opinion, to be content. But already alone they only in the purchase of the second would lead to having no actual claim to the ground would lead to further retroachment, which would, in the end, make it impossible for science to be efficiently provided for. The Chancellor of the Exchequer,—I am nazious to show you that, quite irrespective of my interposition, we have not been than the contraction of the contraction of the contraction of the Name of a safety section of the first and the same of the future

been to satisfy science in the most ample manner for the future

been to satisfy science in the most ample manner for the interest. Sir B. Samuelson said the art gallery was looked upon with a great deal of jealousy, and in the next place they feared that the full area of 200,000 feet, which they considered to be absolutely

run area or 200,000 test, which they considered to be absolutely necessary for the future requirements of science, would be encroached upon Sir Frederick Bramwell, who was chairman of the department all committee which considered the question in 1888, suid there was a sate to the north of the City and Guidé Institute, and from the east to the west there were galleries, and a cross gallery was being made by the Imperial Institute which would give com-munication one with the other, and which would be in immediate connection with the site he suggested. That would be an admirable art gallery He would be glad to see the Science School able art gallery He would be glad to see the Science School and everything belonging to it moved so that there might not be a road dividing it. He trusted that the anonymous donor might be induced to see that his gift would prove more graceful if he did not impose a condition that would have so prejudicial an effect as would be the case if the recommendations of the two committees he had referred to were disregarded.

committees he had referred to were disregarded.

Lord Cranbrook—The question, of course, so far as it can be considered will be considered, and I quite agree with 5 in Federick Brinned lihat nobed you predict what may be done one, but which may possibly have to wait. But in the meantime I can sature you that the interests of science will be most carefully considered, and that we will do what we can in order to further them.

Prof Story-Maskelyne, having thanked Lord Cranbrook and Mr Goschen for the hearing that had been given to their

views, The deputation withdrew

We have received the following communication on this subject .-

Sir,—The curious admissions made by Mr. Goschen to the deputation which waited upon him and the Lord President indeputation which wanted upon min and the solution dicate very clearly that we have, in the present muddle touching the site of the Art Gallery, another of those instances in which see and or one are susiety, another or those instances in which we suffer from the system, or, rather, want of system, which is characteristic of the relation of Government to science, and from the absence of sclennife knowledge in those branches of the public service by which matters of the highest scientific moment are settled. A reference to some of the facts will, I think, show this very clearly.

The particular site which has been allocated by the Government in this way for the purposes of an art gallery forms part of a piece of land which, as is well known, only last year was deliberately purchased by the same Government for scientific purposes—to be quite accurate for "acience and the arts". purposes—to be quite accurate for "science and the arts"— that is, science and its manifold applications. The space of ground thus purchased was less than half the space alloited to the Natural History Massium! I say deliberately, because the pur-chase of the land in 1890 had for its object the carrying out of one of the recommendations of the Duke of Devonshire's Com-mission, which dates from the year 1874—namely, the crection of a Science Massium.

of a Science museum.

This object so warmly commended itself to the Royal Commissioners of the 1851 Exhibition that in 1876 they offered the land on which the Imperial Institute is now being erected and a sum of £100,000 towards its realization

Few acquainted with the

manners and customs of our Government Departments in relation to science will be surprised to hear that this magnificent offer was refused; and it is to prevent a like disastrous mistake being now made that the strong memorial was presented to Lord

oow made that the strong memoral was presented to Low-Salbary.

Salbary.

S uon and uses.

This was the ideal recommended to the Government by the Duke of Devonshire's Commission in 1874, and such is the ideal now being carried out by several of our provincial Colleges
As all Londoners know, at present the Science Schools and the collection of scientific apparatus, which are both necessary for the realization of this scheme, are placed one on the east side of Exhibition Road, and the other chiefly in the Western Galleries. If the apparatus is employed in teaching, it must necessarily be transported about a quarter of a mile and back from the one to the other. And this accounts for the strange processions occasionally met in the neighbourhood of the Museum

carrying delicate apparatus along the street alike in wet and dusty When the new piece of land was purchased last year on the When the new piece of land was purchased last year on the recommendation of a very strong Treasury Committee, it was naturally expected that, as the overcrowded state of the existing school buildings rendered immediate action imperative, plans would be at once drawn up for an extension in the closest

possible contiguity with the present building—that is to say, on the part of the newly-acquired plot immediately fronting it It was also believed that the Science Museum would be built in close and organic relation with the new laboratories, and that a scheme would be initiated which would supply pressing needs, and could, in course of time, be developed into the ideal institution which has been sketched.

These plans, to the carrying out of which the friends of science confidently looked forward, would be rendered absolutely futile by the grant for art purposes of the particular plot the altenation of which from the use for which it was purchased will render the objects of its purchase nugatory.

All hope of a compact site, therefore, for the future worthy representation of physical science would disappear as the result of this action of the Government

e public have a right to know who is responsible for this, and how far the scientific officers of the Science and Art Department have been consulted If they have in any way been consenting parties, it seems probable that they will have a mauvais quart d'heure with their scientific brethren who have signed the memorial and who attended the deputation; if they have not been consulted, the whole transaction is a disgrace to our administrative system.

An idea of the impasse in which this decision has landed matters scientific at South Kensington was to be gathered from one of Mr. Goschen's replies as to the makeshift arrangements at first proposed :-
(1) The second half of the Science Schools is to be built

somewhere at the back of the new Art Gallery This at once prevents all close relationship between the two halves of the same institution.

prevents all close consumant between the two navies on the control of the control

are to be widely sundered, while any organic connection with the Science Museum is to be rendered impossible.

I do not think, Sir, I need occupy any more of your space with recent history, the whole question stands thus .--

(1) In our museum system Art, Antiquities, Literature, and Natural History are magnificently provided for (2) Science is not provided for at all in any permanent

(3) During the last twenty years Royal Commissions, Treasury of Departmental Committees without number, and deputations, and Departn

and Departmental Committees without number, and deputations, where pointed out this gap, where pointed out this gap, which is a simple property of the Exhibition of 185; sold cheap, a plot of land to be used for this purpose alone (5) The plot is less than half of that on which the Natural History Museum stands

(6) The Government now barter away a large portion of this small site for a mess of pottage age I am, Sir, Your obedient servant, F.R S

MOTES

THE ladies' souds of the Royal Society will take place on Wednesday, June 17

On Tuesday the Convocation of the University of London considered the Draft Charter drawn up by the Senate A resolution to the effect that the scheme should be approved was moved by Lord Herschell, seconded by Sir Richard Ousin, and supported by Dr Pye Smith Mr Bompas, Q C, Mr. R H Hutton, and others spoke on the other side. In the end the scheme was rejected, 461 voting against it, and only 197 recording their votes in its favour The whole subject needs to be thoroughly reconsidered, as the question of the higher tenching, one of the points first insisted on, seems to be dropping out of view. To educationists this is, of course, the really important element of the subject, and it cannot be for ever tolerated that the existence of an Imperial Examining Board, because it has been wrongly named, should prevent the largest city in the world from securing educational advantages which have for centuries been possessed by many a small German town

THE Government of New South Wales have granted for the purposes of the Sydney Biological Station a plot of land of two acres on the north shore of Port Jackson at a part where the littoral fauna is particularly rich, and where the conditions are in other respects highly favourable. The Royal Society have made a grant of £50 towards the cost of the proposed new

Tite annual meeting of the German Ornithological Society is being held this year at Frankfort, and the attendance is some what larger than usual, as several ornithologists have stopped at Frankfort on their way to the Congress at Budapest. The subject of zoological nomenclature was considered on Tuesday, when a discussion on the rules proposed by Dr Reichenow and Graf von Berlepsch ensued. The question will be further considered at the forthcoming Ornithological Congress at Budapest, where Dr Reighenow will be the exponent in the systematic

THE conversations of the Society of Arts will be held at the South Kensington Museum on Wednesday evening, June 17

M. EDMOND BECQUEREL, son, and successor as Professor, of Antoine César Becquerel, died on Monday, in Paris, at the age of 71. He was the author of treatises on the solar spectrum, the electric light, magnetic phenomena, and other scientific subjects.

PROF. JAMES GEIKIE, of the University of Edinburgh, has been delivering a course of lectures at the Lowell Institute, Boston, on Europe during and after the Ice Age. The course hegan on March 13 and ended on April 10.

40

 \boldsymbol{A} shock of earthquake was felt at Athens on Monday evening.

THE fourth summer meeting of University Extension and other students, to be held at Oxford in August, will be divided into two parts. The first part of the meeting will begin with an anaugural lecture by Mr. Frederick Harmson on Friday evening, July 31, and will end on Tuesday evening, August 11. The second part of the meeting will begin on Wednesday morning, August 12, and end on Monday evening, August 31. In natural scenee fifty-indeed lectures will be delivered, and there will be classes for practical work in the University laboratory and other exercises. A summary of the state of facts and the first state of the first state of the first state of the first state of facts have been offered by vanous gentiments for the purpose of natural grant terms of the first state of facts have been offered by vanous gentiments for the purpose of natural grant terms of the first state of facts have been also for the first state of facts have been also for the first state of facts have been also for the first state of facts have been also for the first state of facts have been also for the first state of facts have been also for the first state of facts have been also for the first state of facts have been also for the first state of facts and the facts of facts and facts and facts and facts and facts are facts and facts and facts and facts and facts and facts and facts are facts and facts and facts and facts and facts are facts and facts and facts and facts and facts are facts and facts and facts and facts and facts are facts and facts and facts and facts and facts are facts and facts and facts are facts and fa

A GLASS GASS just placed in the Mammal Gallery of the British Museum contains a sense of specimens of two of the largest species of Ausaice Wild Sheep, collected and presented to the auston My Mr. St. George Luttledisk, the well-known sportsman. Three of these represent Marco Polo's Sheep (Jowy Ash) from the Faunt Range, and three of them the Ammon Carlot of the Carlot of Car

THE Australasan Association for the Advancement of Selence has published the Report of its second meeting, held at Melbourne in January 1890. The volume is edited by Prof. W Baldwin Spencer No one who glances over the volume can fail to recognize that the Association is likely to exercise a most important influence on the development of scientific research and thought among our kinsfels in the Australasan colonies.

The Ealing Microscopical and Natural History Society, of the which the Rev. of Hendow is Presiden, has issued its Report and Proceedings for 1850. The Committee are able to record that the work of the Society proceeded quelty has testedly on the lines laid down in previous years, the evening meetings, the executions, and the conversation-having all been held in their appointed seasons, and having had a full measure of success. Among the subjects brought before the evening meetings were "Adventures in Siberia," by Mr. H. Seebohn; "The Natural History of Malix," by the Rev G. Henslow; "Distorns," by Mr. E. M. Nelson; and "A Gossip on Mush-rooms and Toodstoots," by Dr. M. C. Cooke

DURING the last fortnight, according to the Caro correspondent of the Times, there have been in Upper and Lower Egypt large swarms of locuts, which have caused much alarm. Egypt large swarms of locuts, which have caused much alarm, sait is believed that they originate from eggs laid to the country last year. The damage done to the young maze, sugar, and cotton is an yet integration; though some individual growers have had to re-row cotton patches which had been devastated. The provincial Mudits have received orders to do everything in their power to secure the extermination of the locusts. The correspondent suy that this is the most serious respersance of an old Egyptian plague that has been recorded for about forty years.

A CIRCULAR relating to certain alterations in the Science and Art Directory for the session 1891-92 has been issued to NO. II24. VOL. 44

managers of schools of science and art by the Lords of the Committee of Council on Education. The following is an outline of the alterations, so far as they refer to science, or to science and art together -(1) Subject 6-Theoretical Mechanics-will be treated in two subdivisions: (a) the mechanics of solids, and (b) the mechanics of fluids-liquids and gases-payments being made on each subdivision as a separate subject. Subject 8-Sound. Light, and Heat-will be treated in three subdivisions in the advanced and honours stages, which may be taken, and will be paid upon, separately The elementary stage will still include all three subjects, but the syllabus will be curtailed and rendered easier, especially in "Sound" (2) These subdivisions will not be considered as separate subjects in the interpretation of the rule which limits the number of subjects on which payments may be made on a student in any one year (3) The number of National Scholarships in science to he competed for each year will be increased from 14 to 22 (6) In both science and art, the prizes of books, as distinguished from certificates, will be largely reduced in number, and only given in competition, those prizes which are now awarded simply on the student attaining a certain standard of excellence in the examinations being abolished. The time has passed when such prizes from a central authority, which entail a disproportionate cost and delay in administration, were justified by the necessity for stimulating science and art schools, and the Lords of the Committee of Council on Education are of opinion that the scholarships which will be substituted for them will be more useful. They trust that those interested in education in the several localities will themselves provide prizes of books for deserving students which may be useful to them in their studies

ACCORDING to the Indian papers, a persistent effort is being made by the Geological Department of the Government of India, in association with the Burman Government, to explore the tip resources of Tenasserim. The flourishing condition of the almost adjacent Malay States of Perak and Selangor, which are under British protection, is mainly due to the income derived from tin royalties. A year ago an expert was borrowed from the Straits Settlements and placed in Tenasserim under Mr. Hughes, of the Geological Department. The party has this year been joined by Dr Warth, the officer who did very good work for the Government in the Punish salt mines; and Dr. King. the Director of the Department, has left Calcutta for an inspection of the survey operations which have been conducted during the last twelve months. It is now two years since the Chief Commissioner of Burmah sent a special officer to report on the tin mines of the Straits Settlements, and the present explorations are being conducted in pursuance of the recommendations then made.

A PASSAGE in the correspondence of Leibultz and John Bercoult, to which Prof Hellmann has recently called attention in the Meteorologicale ZeateAry/I, indicates that Leibultz concived the dean of the ancroid borneter, which was fire tyracticulty realized by Vids in 1847, I Bernoulli, early in the eighteenth century, was considering the phosphorescence of mercury in the boroneter, and the possibility of making a new seriescent in the state of the possibility of making a new seriescent and such the dear of a baroneter for traveller; and Leibultz tells him he had thought of a portable baroneter, without mercury, in which a metallic case should be compressed by the weight of the sur. A bidder, or leather case, which he also suggested, Bernoulti condeted would be too hyproscopie.

MESSES, MACMILLAN AND Co. have just published "Natural Selection and Tropical Nature—Essays on Descriptive and Theoretical Biology," by Mr. Alfred Russel Wallace. The volume consists mainly of a reprint of two well-known volume

of essays—"Contributions to the Theory of Natural Selection,"
and "Tropical Natura and other Essays," Several essays have
been either wholly or in part omitted. On the other hand, the
sattor has included essays on the antiquity of man in North
America, and on the debt of science to Darwin, which have
billeto been accessible only in the periodicals where they
originally appeared. The text has been carefully corrected, and
some important additions have been made

A SUPERAMENT to Dr. T. Luder Bronton's "Text-book of Pharmacology, Therapeutes, and Materia Médics" has been usued by Mesers. Macmillan and Co. It presents the additions made in 1890 to the Bruths Pharmacopenis of 1885, although the medicanal substances contained in the British Pharmacopenis of 1885, are connected in the body of the work under the natural davanous of the muneral, vegetable, and annual kingdoms to which they belong, the author thinks it is easer to remember the additions by grouping them together according to their uses. A complete alphabetical list of them is also

A "BOTANICAL ADDRESS BOOK" has been issued by the well-known I cipzig publisher, Wilhelm Engelmann It contains a list of living botanists, and of botanical institutions, societies, and periodicals

F. A. Brockhaus, of Leipzig, has issued a catalogue of scientific works which are offered for sale at his catablishment, It includes, besides books, a large number of scientific periodicals and the publications of many learned societies.

THE 92nd and 93rd Parts of the "Landerkunde von Europa," edited by Alfred Kirchhoff, have been published They present an excellent account of various parts of the Balkan Peninsula

WILLING's (late May's) useful "British and Irish Press Guide" for 1891 has been published. This is the eighteenth annual issue

THE first number of a monthly journal for civil, mechanical, and electrical engineers, was published last week. The new journal is called the Engineering Review, and is edited by Mr. H. C. E. Andrée and Mr. Edward Walker.

AT the meeting of the Linnean Society of New South Wales on March 25, the Rev. Dr. W Woolls read a paper on the classification of Eucalypta. After critically reviewing the characters of Eucalypta which have, from time to time, been made use of for classificatory purposes, more particularly those of the anthers and of the bark as set forth in the anthereal and cortical systems of Bentham and Maeller, the author suggested the probable value of a dasafication based on the characters of the fruit—nuch as shape, position of the capsules, the number of cells, and the appearance of the valves, &c.

CAPTAIN PETERSEN, of the Swedish barque Eleanora, noted a submarine earthquake in the volcanic region of the Atlantic west of St. Paul Rocks on March 13 between 7 and 8 p.m. According to a statement in the printed matter prepared for publication on the Pilot Chart of the North Atlantic Ocean for the present month, the ship was heading north-west, going about 3 knots, with a light easterly wind and calm sea, when a noise was heard on the port side, like a heavy surf, and almost immediately the sea began to bubble and boil like a huge kettle, the broken water reaching as high as the poop-deck. No distinct shock was felt, but after the disturbance struck the ship she continued to tremble as long as it lasted. After about an hour it ceased for an hour, and was then followed by another similar disturbance. A bubbling sound was all that could be heard, and the water appeared foamy, but it was impossible, on account of the darkness, to say whether it was muddy. The next day weather and sea were as usual. Position at 8 p.m. lat. 3° 47' N., long. 42° 03' W. The region from St. Paul NO. 1124, VOL. 44]

Rocks to and including the Windward Islands is especially subject to earthquakes, and reports similar to the above are often

AT the ordinary meeting of the Institution of Civil Engineers on May 5, Mr. William Langdon read an interesting paper on railway-train lighting. He pointed out that the main questions to be determined were whether electricity was safe, trustworthy, and less costly than other illuminants. The fact that electricallyhighted trains had now been running for a considerable period without accident appeared to him conclusive evidence of its safety, and experience had shown that there was no reason to doubt its trustworthiness where efficient provision had been made; and he believed that when the cost of applying any of the illuminants, whether oil, gas, or electricity, to a complete railway system was taken into account the latter would be found the most economical Regarding electricity as the illuminant which would, at no distant date, be universally employed for train lighting, Mr Langdon suggested the desirability of arriving at a common basis with regard to the following fundamental points; (1) electrical system, (2) form and position of the electrical couplings, (3) pressure of current. Unless this was effected it was to be feared that unnecessary difficulties might be created by the diversity of the plans adopted

MR C. I. HANSSEN, a civil engineer of Copenhagen, has proposed a new international system of measures and weights, to which he invites our attention. He hopes that England will adopt his system, and that then the United States and Russia will follow, and thus the new system would become entirely international. Mr. Hanssen proposes that the English foot should be increased in length by about 1/2500th part of its present length (from 1 00000 to 1 000403), the pound avoir dupois, the ounce, and the imperial gallon, remaining unaltered, Tre cubic foot, as Mr Hanssen states, would then contain exactly 1000 ounces of distilled water at 4° C; and its inter comparison with the metric units of weight, length, and volume, would become apparently easy. We fear, however, that there is little hope in this country of introducing any such new system As Mr Chaney has indicated in his report on the Metric Conference, there are only two things possible in the metrology of this country · either to adhere to the present Imperial system, or to introduce the metric system. No half-way or modified Imperial system, such as Mr Hanssen would propose, appears to be possible.

THE Deutsche Seewarte has published, in vol xiii of its Aus dem Archiv, a paper by Captain C. II Seemann, one of the assistants in that establishment, entitled "Weather Lexicon an Index to the European Weather Charts from 1876-1885." The author considers that the principles we at present possess for forecasting the weather-e.g. Buys-Ballot's law, the relation of the tracks of depressions to the distribution of pressure and temperature, or the dependence of the lower air currents upon the upper currents-are not sufficient for the purpose, and he has made an index of the various similar types of weather-charts He has calculated the barometrical differences which occur each day in three directions (1) from Hamburg towards the northwest (Stornoway); (2) from Hamburg to the south-west (Biarritz); and (3) from Hamburg to the north-east (Helsingfors), and, by knowing the difference for any day, a reference to a table of such differences shows the dates of other charts with similar conditions, so that, by selecting one which appears most suitable to the present conditions, we may judge of the probable weather from that which actually followed that particular type. In the paper in question, only barometer and wind have been taken into account, the distribution of temperature would, of course, have great influence upon the changes of weather, but the author preferred to postpone the consideration of that element in this primary classification.

In the new number of the Journal of the Bombay Natural History Soclety, Lleutenant H. E. Barnes continues his interesting papers on nesting in Western India. Speaking of housesparrows, he says that no amount of persecution seems to deter them from building in a place when they have once made up their minds to it. At Deesa, he found that a pair had built a large nest in the antiers of a samhur in the verands. Another pair made a nest in the soap-box in the bath-room, and although the nest was destroyed several times, they would not desist, and at last, "from sheer pity," he had to leave them alone. The most peculiar case was when a pair had a nest in a bird-case hanging against the wall, just above where the "durzi" sat all day working, and close to a door through which people were passing in and out continually. The door of the care had been left open, the previous occupant having been transferred elsewhere. Not only were four eggs laid, but the nestlings were reared, although the cage was frequently taken down to be shown to visitors. Once the eggs were nearly lost, a boy having taken them out. The fuss made by the birds led to the recovery of the eggs. The author has a curious note on another peculiarity of sparrows, "I have often," he says, "had to turn the face of a looking-glass to the wall to prevent them from injuring theniselves, for immediately one of them catches a glimpse of himself in it, he commences a furtous onslaught on what he imagines must be a rival, and, if not prevented, will continue fighting the whole day, only leaving off when darkness sets in, recommencing the battle at dawn the next day. I once tried to see how long it would be before the bird gave in, but after two days, seeing no likelihood of his retiring from the unequal contest. I took pity on him and had the glass covered The bird did not seem in any way exhausted, although I do not think that he had a morsel of food for two days."

Some remarkable electrical phenomena accompanying the production upon the large scale of solid carbon dioxide are described by Dr. Haussknecht, of Berlin, in the current number of the Berichte of the German Chemical Society In order to obtain large quantities of solid carbonic acid it is found most convenient in practice to allow the liquid stored in the usual form of iron cylinder to escape into a stout canvas hag, best constructed of sail-cloth or some such strong fabric, instead of the usual lecture room receiving apparatus, the cylinder being inclined from the vertical so as to permit of a ready and uniform ext from the opened valve The liquid under these circumstances issues at pressures varying from 60-80 atmospheres, and a compact snow-like mass of solid carbon dioxide is formed in the canvas receiver, owing, as is well known, to the extreme lowering of the temperature of the liquid due to its sudden expansion and the accompanying absorption of heat When the experiment is performed in the dark, the canvas receiver is seen to be illuminated within by a pale greenish-violet light, and Dr. Haussknecht states that electric sparks 10-20 cm. long dart out from the pores of the cloth. If the hand is held in these sparks the usual pricking sensation is felt, similar to that perceived on touching the conductor of an electric machine at work. Dr. Haussknecht further states that the phenomenon is very noticeable in the dark whenever there is a leakage in any portion of the compressing apparatus or the manometers connected therewith The reason assigned for this development of statical electricity is similar in principle to that usually accepted in explanation of the hydro-electric machine of Sir William Armstrong. As the liquid carbonic acid is issuing from the valve it becomes partly converted into gas which is violently second through every pore of the canvas Moreover, carried along with this stream of gas are great quantities of minute globules of liquid, which are brought in forcible contact with the solid particles already deposited. Dr. Haussknecht therefore considers that the electrical excitation is due mainly to the violent friction between these liquid globules and the solid soon. It is represental for the successful reproduction of these electrical phenomens that the carbon disorded should be absolutely free from admitted air; that prepared striftically yielding much finer results than that obtained from natural values, which later contains considerable quantities of air. The luminosity is not generally developed in the interior of the receiver until a curat of solid carbonne and o'g-1 cm. thick contains the contains of the co

THE additions to the Zoological Society's Gardens during the past week include two Brown Capuchins (Cebus fatuellus & d), an Ocelot (Felts pardalis), a Coypu (Myopolamus coypus), two Ring-tailed Coatis (Nasua rufa), two Cayenne Lapwings (Vanellus cayennensis), seven Burrowing Owls (Spectyto cumscularsa) from South America, presented by Mr. James Meldrum. a Pig-tailed Monkey (Macacus nemestrinus 9) from Java, presented by Mr. C. Powell : a Common Hare (Letus en uneus). British, presented by Mr. H. T. Bowes, three Pintails (Dofila acuta & 6 9), European, a Mandarin Duck (Ax galericulata 9) from China, presented by Mr G. F. Mathews, R N , F Z S , a Common Bon (Bon constructor) from South America, presented by the Directors of the Museum, Demerara; two Cheer Pheasants (Phasianus wallachu & 9) from Northern India. twelve Common Teal (Ouerquedula crecca, 4 &, 8 9), European, purchased; a Viscacha (Lagostomus truchodactylus), a Red Kangaroo (Macropus rufus), born in the Gardens

THE IRON AND STEEL INSTITUTE.

ON Wednesday and Thurday of last week the annual spring meeting of the fron and Steel Institute was held. The gathering was announced to exceed over Friday also, but for meeting, the second day's proceedings were so hurried through that all the basiness was disposed of by half-past one o'clock on the second day, no less than surpers Sent states at the one test second day no less than surpers Sent states at the one test second day no less than surpers Sent states at the one test second day of the meeting might almost as sell have been dayened with and copies of the papers given to members to take home to read at their feature. It is seldom that we have been sent to be sent t

abolder, not resistent apparently using only anatoms that the should be no fatesmon to protoning the proceedings, should be no fatesmon to protoning the proceedings. In the manufacture of wer material in the United States, by Mr W. H. Juques, of Bethlehem, U.S. A., on test for sted used in the manufacture of artillers, by Dr. Wm. Anderson, Director Central Ordinance, on certain promotive measurements and central off-ordinance, on certain propositions, or a common promotive measurements and on the changes in loss proton by Frof. Robert-Austria, F.R.S., on the changes in loss proton by Frof. Robert-Austria, F.R.S., on the changes in loss proton by Frof. Robert-Austria, F.R.S., on the changes in loss proton by Frof. Robert-Austria, F.R.S., and the composition of furnace charges, by Mr. H. C. Jenkins, on economical publing under by Prof. Thomas Turner, Birmingham is on the mero structure of steel, by Mr. Turner, Birmingham is on the mero structure of steel, by Mr. M. C. S. Tarks. There were there other papers which were not read.

not read. Upon the members assembling in the theatre of the Institution of Civil Engineers, which was lent for the occasion by the Council of the Later Society, according to their hospitable Council of the Later Society, according to their hospitable chair. After the usual formal business had been transsiered, the new President, Sir Frederick as lade, F.R.S., was dupli installed, and at once proceeded to deliver his inaugural address. Sir Frederick is also this year President of the Buttish Association, Present the Council of the Section of the Council of

ing a wide range of subjects and a long span of time. The duration of Sir Frederick Abel's official life has been long, exceptionally long for the years he has lived, for he obtained employment in the Government service at an early age. It was shortly after the outbreak of the Russian War that he succeeded the illustrious Faraday in the Professorship of Chemistry at the Royal Military Academy, and since then he may be said to have seen almost the whole history of the hirth and subsequent have seen almost the whole history of the hirth and subsequent growth of applied sceneet in consection with the industries of growth of applied sceneet in consection with the industries of us in his address, bose who, in this country, appraised, at their proper value the services which the analysical and scientific chemist could render to the irron-matter and manufacturer of analysis. Was just in process of application, volumetries analysis was altogether in its infancy, and spectroscopic analysis was not rendered to the mediatory operations in the Aresual at war dreams of . The mediatory deportation of the Aresual at Woolwich were limited to the production of small castings of Woolwich were limited to the production of small cassings of brass for fittings of gui carriages, and to the casting of bronze ordance for field service. Our supplies of cast-tron ordance to the cast of the cast of the cast of the cast of our most consent ones when the cast of the cast of the cast of the supplied from private works. What Woolwich has become since those days—and in spite of its falls of administration it a something of which the country may be proof—and how large parts. If reference, has borne in this development, most of our a part SIF Federick has borne in this development, most or our readers must be well aware. In those days our most powerful guns were 8-inch smooth bore 68 pounders of cast-iron, weigh ing 95 hundredweight, and fired with a charge of 18 pounds of powder. Now we have the 110 ton breech loading rifled gun, built up of 14eel hoops and tubes, the calibrate of which is 16; built up of steel hoops and tubes, the calibre of which is "16 inches, and which throws steel projectle weeghing 1800 pounds that the 110-ton gui is in advance of its time—our mechanical skill and engineering knowledge not pet being sufficient to properly carry out the design—it would be difficult perhaps to find a more saming resumple of the application of scientific principles more saming aroung the time of the supplication of scientific principles considered the supplication of the deviation of the deviation

Woodwood use a compared to the state of the completed their work. Shoust use commenced, it will do much towards lightening the work of those who have to compare much properties. The state of the state of the work of th is astuafactory to learn that "the systematic appuration of sorby's system of microscopic examination of perpared surfaces of steel and iron is continually extending at the German works, and that many series of experiments have demonstrated that by this system of examination characteristic features of grades of the system of examination characteristic features of grades of the system of the iron may be discovered, physical differences co-exist iron may be discovered, physical differences co-existing with identity of chemical composution explained, and evidences of between grounds of disastern obtained." A very nateracting subject nest occupied a place in the address. This was the self-destruction, if one may use the term, of steel projectiles by the development of crucks. It is well-known that steel prothe development of crucks. The steel known to be a steel prothe development of the steel pro
the steel protection of the steel pro
the steel protection of the steel protection of the steel pro
the steel protection of the steel protection of the steel pro
the steel protection of the steel protection of

place. The cause doubtless is the surface treatment which the shot is subjected in order to get the requisite hardness, and which leads to internal strains being set up. In one case mentioned in the address the head of the up. In one case mentioned in the address the head of the projectille had been thrown to a distance of many feet by the volcent spontineous reputer of the metal. The importance are proposed to the proposed to the projectile and the projectile and the projectile, which had to be the behaviour of chrome steel projectile, which had to be the behaviour of chrome steel projectile, which had to be the behaviour of chrome steel projectile, which had to be the behaviour of chrome steel projectile, which had to be the behaviour of chrome steel most behaviour to a distribution of the projectile and the subject Six Frederick referred to a previous report in which he dwell upon the effect of times in establishing chemical equilibrium in masses of metal. He slio quoted a letter written to him by Thomas Graham, when blaster of the Min, in which was discussed the tendency to the development of cracks in tempered steel dies, and stating that in the Mint it was generally considered steel dies, and stating that in the Mint it was generally considered that if such dies were kept in soree for a year or two, they became less apt torrick when in we, and council more preceded to the property of the property of the considered in the manufacture of steel ordinance, and an in-tance was given by the lecturer of the tube of a large gun which had fired three proof rounds. A circumferential crack. was found to have become developed in the front threads of the was found to nave become developed in the front threats of the breech screw, and, upon removing the jacket from the tube the crack extended forward along the chamber and into the rifting When the tube was placed in the lather, with a view to cutting oil the injuriel portion, the crack suddenly developed itself with a the mysrel portion, the crack suddenly developed iterit with a doubt report, and final along to within eight feet of the muzile, a spral crack at the same time ran completely round the tube, which fell at two upon removal from the lather. This metance will strengthen the hands of those who are opposed to maintaining the parts of a steel gain, and Sir Frederick's own hardening the parts of a steel gain, and Sir Frederick's own hardening the parts of a steel gain, and Sir Frederick's own the steel of the stee exercised in the case of particular qualities of steel is that of developing minute fissures or cracks in the metal, either super-ficially or in the interior of the mass. This cannot, of course, be rectified by any annealing process, and it is still a question, to be determined by the teachings of experience and the result of investigations, whether any definite or reliable modifications in the composition of steel used for guns, tending to secure the desired combination of hardness and tenacity may not be introduced, with the result that a method of treatment of the metal may be discarded which, however carefully applied, and however may be discarded which, however carefully applied, and nowever efficient the means adopted for reducing or neutralizing its possible prejudicial influence upon the physical stability of the parts of which ag un a built up, carries with internet elements of uncertainty and possible danger." Dr Andreno's remarks on the subject of orli-interienting inhould salo be read in connection on the subject of orli-interienting inhould salo be read in connection the whole, perhaps, it would not be rash to predict that the development of the product of t days of this process are numbered in connection with the manu-facture of steel ordnance for Her Majesty's service. For a long time many of our best authorities have been opposed to it. We have not space to follow the address into the subject of

the effect of silicon in cast-iron General interest in this matter was aroused a year or two ago by a paper read before the Iron and Steel Institute by Thomas Turner, of Mason's Coilege, and since then the investigation has been followed up by and since then the investigation has been followed up by German experimentalists, with a general result that, under certain conditions, it is concluded that silicon will contribute to the production of dense and homogeneous castings. The following passage from the address speaks for itself. It would be well it it could be printed and distributed to every

British iron or steel maker :-

Bruths iron or steel maker:—
"The absolute dependence of the development of new metallungic processes upon the results of the labofits of the analysis,
"The absolute dependence of the declared the analysis,
and the thoroughness with which this all-important fact is
appreciated by the German metallungic establishments, afford
were occasion for a reguella recognization of the datasets which
were constant for a reguella recognization of the advantages afforded by the constant parsent of scientific
search, and the thoroughly effective, systematic, and direct
duly operations at works of the scientific investigation to
the
duly operations at works of the scientific investigation to
the duly operations at works or have made important progress in, these directions. It has certainly been humbituing to
the to daily that it industries which the genine of midrodaul

Englishmen, possessed of exceptional powers of applying to important practical purpose the results of research, have created and have developed to an extent foreshedowing their high importance, gradually passed out of our laxeds through the farmed the should be considered to the first three powers are made the shoulded dependence of progress in and industries upon the constant pursuit of chemical research into the far-reschiling and continuity spreading raunfactions of organic chemistry. Thus, in fields of work, where, in days past, and even of late, our modurativit chemists have been content to pursue even of late, our modurativit chemists have been content to pursue even of late, our industrial chemists have been content to pursue their attempts at progress with the co-operation of one or two young chemical assistants, small armies of highly-trained chemists, who have guned academic honours, and have won their pursues the content of the ever and anon, they result in some fresh discovery of great tech nical importance and high commercial value Similarly elaborate

nical importance and high commercial value Similarly elaborate and comprehensive arrangements now exist at important German fron and steel works for systematic investigation and comparison finaterials of products and processes " but for five five with the product and processes". We must hurry over the remaining parts of Sir Frederick's "ddress, and can only mention some of the chief subjects touched upon, referring our readers to the Proceedings of the Institute for faller information. Thus we find the following matters occur. for fuller uniformation. This we find the follows of mattern course propagation to the presence and effect of nutropen in iron; the state in which carbon exists in steel; Omnoni's study, by means of the Lo Chretcher promoter, of the slow cooling of and the existence of two silotropic forms of iron, the effect of asimumum ir nor; Hadfeld's researches in connection with manganess steel; the progress of nuclei steel, and the unterthe section of carbon existence which is the steel of t Interesting and characteristic address

Only one paper was read on the first day of the meeting This was Dr. Anderson's contribution on tests for steel used in This was Dr. Anderson's contribution on tests for steel used in the manufacture of artillery. The manonement of a contri-bution on this subject by the Director-General of Ordanoe Fectores had caused a good deal of interest both among the screenite and manufacturing members of the Institute, more specially as it was known that the Government sutherites had been supported by the order of the property of the angular bowever, the meeting was a little too early, so far as Dr. Anderson's renow was concerned, for the new regulations nowever, the meeting was a little too early, 80 ara as Df. Anderson's paper was concerned, for the new regulations have not yet been officially published, and, until they are, it is against official etiquette, if not official artiles, that they should be made known. The paper was therefore very like the play of "Hamtlet" with the Prince of Demank Left out, and bore play of "Hamlet" with the Frince of Denmark left out, and bore evidence of having been brought forward rather with a view of fulfilling a promise than because the author had anything new to advance. It was not Dr. Anderson's fault that his paper was robbed of its chief interest, and certainly the thanks of the robbed of its chief interest, and certainly the thanks of the Council were due to him for good naturably allowing it to stand on the programme. Nowthbranding what we have said, the apper was very interesting, but as we hope to be any I. Anderson again on the subject, when the official veto has been removed by publication of the new tests, we shall treat the matter briefly. It is first pointed out little that the mechanical properties of steel, and the standard of the standard of the standard of the standard of the contraction of the standard of the standard of the standard of the contraction of the standard of the standard of the standard of the contraction of the standard of t and of alloys generally, are anected in a remarkable manner by extremely minute quantities of substances, by the relative pro-crease rapid changes of temperature, which influence dissociation and reveal their effects by recalescence; indicating, to a less degree, allotropic changes in some or all of the components. Chemical sanshysts sufficiently minute to detect even traces of Chemical manyas numerany minus to detect even traces of overly. Support of the control of the c

so far, at any rate, as ordinary lugredients are concerned. The suther thinks it is not sufficiently realized that metals are in-compared to the control of the your could. Like its and water, steel and cast-iron have a greater volume in a solid than an the liquid state, and, therefore, red-volume in a solid than an the liquid state, and, therefore, red-mass although, it should be addreft, cold cast-rorn will at first also it as a though, it should be addreft, cold cast-rorn will at first also it as a farey red. This was shown by the well-known as a shount to a cherry red. This was shown by the well-known float when it has acquired a sufficient degree of heat to hung it about to a cherry red. This was shown by the well-known experiments of Mr. Weghtson, referred to at the meating. The manuser as which, during cooling, compressive stream of the state of definite compound of carbon and iron dissolved in an excess of definite compound of carbon and iron dissolved in an excess of tron, and as a facely subdivided carbon diffused through the mass, is considered, and the suthor expresses an opinion that the "apparently capricous behaviour of stell" is due not only to the internal stresses engendered by oil-hardening, but also to the circumstance that the chemical condition of the steel and its molecular structure are greatly influenced by comparatively slight errors of judgment, or by carelessness in the adjustment of the temperatures at which the operations are performed.

of the temperatures at which the operations are performed.
A discussion followed the reading of the paper, in which the
most interesting incident was Mr. Wrightson's description of
the experiments to determine the votume of east-iron at different
temperatures. Mr. Edmunds, of Woolwich, defended the
strictures and the stricture of the stricture

f manufacturing operations.

great satisfaction by prominent man over the man and common with the man and t centage of carbon from 0.1 to 0.2, the maximum tenacity is attained, not at 3300° C, but at a much lower temperature—about 1000°—below the melting point of iron oxide, which, moreover, attanes, not at 150° C. Jost at sunch lower temperature—about 100°—below the melting point of no node, which, meetors, necoting, the melting point of no node, which, meetors, percentage of carbon, this point of maximum tenselly apparently disappears almost entirely, the annealed metal having nearly as high a tenulic strength as the same metal which has been quenched in noil from any temperature ny to a bright to hardened metal became so hard and brittle that it could not be groped by the saw of the testing machine. It will be remembered by those who attended the meeting when Dr. Ball's lase to the same proper to the proper same properson of the the last paper read, that of Lieutenant Jaques, U.S.N., was of such a voluminous nature that it might better be described as a treatise, and is far beyond our scope, as may be judged from its

The autumn meeting of the Institute will probably be held at Birmingham.

THE ROYAL SOCIETY SOIRER.

THE soirdes given by the Royal Society become every year more pleasant. The one held on Wednesday, May 6, was in every sense most successful. We note some of the objects

Mr. I. Wimshurst exhibited an electrical influence machine (alternating and experimental).

(alternating and experimental).

The Trotter curve ranger was shown by Mr. A. P. Trotter. This portable instrument is mended to facilisate setting out large curves for milway and other work. It dispenses with carmon the control of the control of

Fécamp to the south of Paris, but its southern termination has not yet been discovered. The directions of the two lines make it probable that they are parts of the same and they are the same and they are the same and the present day. In the following his the present of the same are marked with an attent. The only fire as an altern the present day are the same are the sa species are marked with an asterias. Ane only 111 is an analysis and The willows are all dwarf species, two of them (Salas herbacea and S. reticulate) still live on the higher mountains of Scotland, the third (S. polari) is an Arcile form now extinct in Britain At the same locality there is another deposit, probably of later date, which contains only plants still living in the neighbourhood, date, which contains only plants still living in the neighbourhood.

including several trees. Thalutrum. *Salix herbacea Ranunculus aquatilis · Salix polaris Viola *Salix reticulata Stellaria media Alnus Empetrum nigrum Patamogeton Eleocharis palustris Oxalis acetosella Hippuris vulgaris Loiseleuria procumbens Menyanthes trifoliata Scirpus pauciflorus Scirpus lacustris Stachys palustris Ausga reptans Chrysanthemum Leucanthemum Scarpus ? Carex? Isortes lacustrus Polygonum aviculare

The Executive Committee of the Silchester Excavation Fund The Executive Committee of the Sichester Excavation Fund exhibited (by permission of the Duke of Wellington) —(1) Iron tools and utensils of the Roman period, found together in a pit in the Romano-British city at Silchester, Hants, in September 1890.—(2) Bronze objects of the Roman period found at

Prof. H. Carrington Bolton, Ph.D. (of New York), exhibited

musical sand, from Arabia, United States of America, and the Hawanian Islands, collected by the exhibitor.

Prof H G. Seeley, F R.S., exhibited remains of Anomodont

Prof H G. Seeley, F R.S. exhibited remains of Anomodonic Reptiles from the Trias, Karoo, Cape Colony.

The Director of the Royal Gardens, Kew, exhibited a collection of views in the Royal Gardens, Kew, showing the development of the Gardens during the last fifty years. This series is a portion of a very extensive and valuable collection of prints, drawings, and photographs of the most interesting features in the Royal Gardens It has been brought together during the past twenty years, and is now deposited for exhibition in Museum

Messrs J. E. H Gordon and Co exhibited Tomlinson regulator for electric light mains. The Tomlinson regulator is intended for use in transformer sub-stations. It is worked by a wire from the central station, but automatically corrects any error of the attendant at the central station Ordinary automatic error of the attendant at the central statom. Ordinary sattomatic sparatus cannot be asiely used for this purpose, as, though should such get out of order when taking out immissioners, no order when pitting in transformers at may burn up the substation. The peculiarity of the new apparatus is that if anything whatever goes wrong, all transformers are at one put in, thus ensuring absolute salety. By the courtery of the Break Company, and of the Metropolation Electric Supply Company, who have

and of the Metropolitan Electric Supply Company, who have enter the necessary machinery, the apparatus has been tried on a large scale in the Brush Company's works. A plant of 1950 without, the new apparatus, with the result of a saving of 42 cut of 100s, or, in other words, with the new apparatus there as a saving of 59 pounds of 00s 19e S c. P. lamp per annum, Six I B Lawes, Bart , F R S , and Dr J. III Gilbert, F R S, showd—(1) Three enlarged photographs of Legominous plants, showd—10 three enlarged photographs of Legominous plants, free intogen. The plants were grown, in some cases with sterilutation, and in others with incrobe seeding of the soil. With mushle microbe-infection of the soil, there was alumped plants, and there was, considently, very convicted featured in fastion of commation of the to called legislimious modules on the roots of the plants, and there was, coundently, very considerable fixation of free nitrogen. The evidence at command points to the conclusion that the free nitrogen is fixed in the course of the development of the organisms within the nodules, and that the development of the organisms within the nodules, and that the resulting nitrogenous compounds are absorbed and utilized by the blade — however the control of the control of the theory of the control of the control of the control of the Lawes, of the Robinsteed drain gauges Old plan of the Mint in the Tower of London, exhibited by the Hou Sir C W Fremantie, K C B This document is described as an exact survey of "The Ground Flot or Plan of the Majesty's Olice of Mint in the Tower of London." It

bears the date 170°, and must have been prepared by the order of Sir Isaac Newton, who was appointed Master of the Mint in 1699. The position of Newton's official residence is shown

Mr R. E. Crompton, M.Inst.C E., exhibited —(t) Section of armature winding, showing copper divided, twisted, and compressed, to avoid loss from eddy currents.—(2) Crompton's method of obtaining accurately sub-multiples of the ohm, for

current measuring purposes.

Prof. Oliver Lodge, D Sc , F.R S., exhibited :—(1) Revolving Prof. Oliver Lodge, D Sc, F.R S., exhibited:—(1) Revolving mror. Rappd revolving milror driven by clock-work, with detachable fan to give moderate speeds, with adjustable man spring to vary the speeds and with vacuum cover for highest speeds (the last not yet satisfactory) Slow moving index, to enable the speed to be determined, and electro-magnetic brake Easile the speed to be determined, and electro stagging the first to regulate its going, or to stop it gradually Merro, 2 3 x 1 cm, silvered back and front, very light, but groung fair definition. It makes 5750 revolutions for 1 of the winding arbor. Used for analyzing sparks, and observing the speed of electric pulses along conductors of various kinds Made by descriptions of the stage of the speed of the

NO. 1124, VOL. 441

sidered time. A coulded and morocel instrument, derrich opportunities, Mr. Chernel T. Doblation, and daily alghed pointer to the dial, thu pointer being moved by hand to the right date; and the clock may then keep ordinary time. The dial is gazed down 1:24, and driven by the minute hand, so as more than the contraction of the contract Leyoun jar circuits arranged at a moderate distance from each other, the self-induction or capacity of one of them being adjustable, with an easy overflow path. On ducharging one of the jars, the other resounds and overflows, being provided with an easy overflow path. The oscillations are much more numerous than with ordinary linear (Hertz) vibrators, and therefore some precision is demanded in the tuning.

Self-recording instruments, exhibited by M.M. Richard Frères

Self-recording instruments, exhibited by MM. Richard Febres Method of scooling pyronetic neasurements at temperatures Method for Seconding pyronetic neasurements at temperatures Assten, C.B., F.R.S. The apparatus is that employed in a research understane for the Institution of Mechanizal Engineers, and is used for automatically recording, by the aid of photography, and is sufficiently and the self-recording the result of self-recording the result of self-recording the result of self-recording the result of cooling of heated masses of metal. Curves are shown to pillutarize the hird of results which are obtained by the aid of the apparatus.

and of the apparatus. Length-measuring instrument, exhibited by Prof W. C. Unwin, F.R. S. In ordinary serve or vernier micrometers the straining of the instrument alters the readings, and in using the training of the instrument and the readings, and in using the the contact is with fixed pressure, and independent of feeling. Delicate levels show when the instrument is adjusted. Portraits of decessed astronomers and physicists, exhibited by Mr. W. B. Croft.

Mr. Killingworth Hedges exhibited:—(1) Electrical safety-valve.—(2) Exhausted bulbs, used to ascertain the space traversed where "of Eshausted bilds, used overtain the space traversed by high teams on thereating each overtain the space traversed by high teams of the traversed with the space of th

of 300 volta, which is the limit of potential fixed by the Board of Trade for currents of low pressions. Foconeter, exhibited by Prof. Silvanus P Thompson By the intrinuent can be determined the position of the two forms of the silvanus professional pr

the displacement to given by the screw is equal to the true local length. Mr. Shelford Bidwell, F.R.S., exhibited; (1) Selennum cells, the electrical conductivity of which is greater in the light than in the dark. (2) A selenium lamp-lighter, lighting an in-candescent lamp automatically when darkness comes on. (3) A than in the dark. (2) A selection lamp-lighter, againing as in-conducent lamp summatically when darkness comes on. (3) A of a ship's light or railway sagnal lamp—Mr W Crookes, F.R.S., exhibited electricity and haybexing—Mr. G. J. Symons, F.R.S., exhibited electricity and haybexing—Mr. G. J. Symons, F.R.S., exhibited electricity and haybexing—Mr. G. J. Symons, F.R.S., exhibited photographs of damage produced by the contrador of August 18, 1890, at Drives (Eare et Loues), France. H. S. L. Symons, F. L. Symons, F. L. Symons, F. L. Symons, enlargements of the soler spectrum, each magnified from the enlargements of the soler spectrum, exponents intera—Mr. George Huggs exhibited photographs of the normal soler spectrum. M. G. Lappanne exhibited colour photograph of the Mr. G. Lappanne exhibited colour photograph of the Mr. G. Lappanne exhibited colour photograph of the substance of the films remaining colouries, but are of the same kind as the colours sees on these plates are produced by the direct action of light; they are not due to any pagments, the substance of the films remaining colouries, but are of the same kind as the colours of soap-bubbles and neutricopent, rush to the film by the stationary weres of incident light during exponen in the camers. These colours are perfectly permanent.

Prof. A. Schuster, F.R.S., exhibited some forms of Clark

Prof. Emerson Reynolds, F.R.S., exhibited: (1) Specimens of tetrathiocarbamid-ammonium bromide, (H₂N₂CS)₂NBr, and related substances. (2) Series of photographs illustrating the application by Colonel Waterhouse of the above bromide to the of istrahipeachemid-diminositum promised, Irl, N_c(S₁)_N(N_f) and of internal processing and the promised of the processing and processing and application by Coloned Waterbusse of the shows bromale for the reversal of the photographic lange on gelation bromide of silver films.—Mr. W. Saville-Kent chilbrid photographs of living cords, taken in Torres Sirunt,—Dr. W. Hanter enhibited a from animal times.—The Committee of the Canera Chib enhibited allotropic forms of silver, prepared by Mr. Carry Lea, of Philadelpha, and described in Americ, Journ. of Seiters for Philadelpha, and described in Americ, Journ. of Seiters for Philadelpha, and described in Americ, Journ. of Seiters for Seiters of Philadelpha, and described in Americ, Journ. of Seiters for Philadelpha, and described in Americ, Journ. of Seiters for Seiters of Philadelpha and Seiters for Seiters f

THE RENUE AND THE KIRRE

AT Monday's meeting of the Royal Geographical Society, Major Claude M Macdonald, H M. Commissioner to West Africa, gave an account of a journey up the Benue and its northern tributary the Kibbé, in the summer of 1889. The its notratern utidutary the KIDE, in the summer of 1809. The Benue, we need scarcely say, as the great tributary of the Niger. Major Macdonald referred to the previous explorations of Barth and others, and to the fact that it has been maintained that a connection existed between Lake Chad and the Benue, by the overflow of the Shari on one side and the Kibb on the the overflow of the Snari on one side and the Aldre on the other. Major Macdonald has been the first to explore the Kibbe, After describing the ascent of the Benué, Major Macdonald went on to say that he and his party started on their journey up the Kibbé in the Royal Niger Company's stern-wheeler the

Brand, on August 21.

The Kibbé at its mouth is some 250 yards wide, while the Beaué is upwards of 600. The average depth of the Kibbé at this season of the year, nearly high water, is from 10 to 12 feet.

On both banks for the first five miles the country is flat and On oon names for the trist five miles the country is nat and well wooded, with patches of bright green grass, and looks very gamey, though owing to the high grass we saw no deer. A noticeable feature some five or six miles from the river is Mount Kane, a rounded hill, some 800 feet high, well wooded to its summit. This hill, from its isolated position, served as an excellent point on which to take angles for mapping purposes. Patches of cultivation were now to be seen on both banks, and Paules of cultivation were now to be seen on footh banks, and after two hours' attenuing the party passed the Fully willage of after two hours' attenuing the party passed the Fully willage of steamer or a white man, did not seem much disconcerted, and, when shouted to in their language, restrined the sultations in a very firently manner. On Angust 22 the Houst anchored of a McConsalt states, "that we had to deal with the purest-heed Falls we had seen so far. The crowd consisted atmost entirely of woman—by far the best-looking we had as yet seen on the west Equatorial Africa. They wore the usual piece of cloth would round ther bodies, leaving their arms and shoulders hore, and reaching down below the knee. Their features, in most cases, appression, and their expression may genile and modest, yet full of vivecity. They told us that the name of their village was Fram, and that it was governed by an anneal was trained to the training the second to the training training to the training training to the training trai

Shortlyafter this the steamer came to a deserted atrip of country, own fifteen miles in length, which was evidently the barrier between the Mahommedan and Pagan tribes it was of an undulating character, with isolated hills, and well wooded. The river was still about 100 yards wide, but commenced to be dotted with contracting and was in part were whallow with a sandy buttom.

sill about too jards wide, but commenced to be dotted with grassy jainds, now as an party weep shallow with a sandy bottom. Next day, as the istement advanced, the river narrowed gand made a sharp bend to the eastward, and approached a new state of the state of the

siteticated back some inner or local state of the property of the control was a control with the control was inhalf and of the control was inhalf of one of the control was inhalf of one of the control was inhalf or one of the contr

"The scenery now was very picturesque; to our right, i.e. the south of the river, some few yards from the water's edge, the mountains rose in some places quite abruptly. These mountains

were for the most part covered with green wany grees very pleasant to the eye. One of two streams trocked down the mountain side, forming now and again potenties westerfalls. The river had studently broadened out to a lake, or, more properly speaking, manh, some three miles long by two wide. The range of grawy mountains I have mentaoned run along the row of the seat and not have to the lake, as far as the eye could see in the direction of the Taburi mark (near the Shart river) was open and grayl undustaing, while from the western shores of the seat and entire the seat of the

and had the appearance of the country places of the nicher mahabitants of the village associated our more-ments with great curroutry. We asked to see the chief of the village, and after a good deat of palware, a man appeared attired in a very statered "tobe" or gown. He had something of the Falbe in his countenance, and was a tall fine man, though of rather worself to get what influences as a tall fine man, though of rather worself to get what influences are could out of him. It is said the name of the hig water we saw was Nabared, but that it was only a fourth that size in the dry season. The name of his willage was Kakea. The channel off the river as along by the mountains. He knew of the Tubun marsh, but had never as distant many days' journey. He knew of no other big water, but would give us a guide to show us the way. The people of the Nabaret district are possessed of calle, but no horses; they live principally on chairra, which they cultivate the propostion, of which we saw a dozen in the lack, though doubtless there may be many more.

"We took our guide on board and endeavoured to make for

consists other may be fine a power and make your discovered to make for Blarke, ilendry mentioned, which appeared to be a village of quite 6000 inhabitants, situate on the north-east shores of the lake, and distant some two suiles from where we were, absalted about a foot, and even less, and though we made every effort to proceed, we were completely halffed; turning back, by direction of the guide, we west for an opening in the high effort to proceed, we were completely halffed; turning back, by direction of the guide, we west for an opening in the high considerable of the stream, which was, lowever, only some 8 yards wide and 25 feet deep, flowing with lowever, only some 8 yards wide and 25 feet deep, flowing with lowever, only some 8 yards wide and 25 feet deep, flowing with newspotton becames to difficult that we had to turn back, having already annabled in the low of our gg, bent our rudder into the maygation became so difficult that we had to turn back, having already annabled in the low of our gg, best our render into the managent the churra staller. The attenum was to part converted to the could not turn, but had to float down backwards for a good half line. The highest point render has a nist agid a half from the walker from Khwa. In the Tabari country, the furthest point exched by any European entering Africa from the north, was been also also also the standard of the control of the form that the control of the co

It seems evident, then, from Major Macdonald's observations, that no connection can exist between the Shan and the Benuc.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

48

CAMBRIDGE.—Mr J W. Clark, Superintendent of the Museum of Zoology and Comparative Anatomy, has been elected to the Office of Registrary of the University, vacant by

elected to the Office of Regultrary of the University, vacan by the death of Dr. Land. Hours, caud has been conferred on Mr. The Engency of the Company of the Company of the Company The Electron to the new lasar Newton Studenships, founded by Mr. F. McClean, are Sir G. G. Stokes, Profs. Darwin and Thomson, Dr. Glaisher, and Mr. Glazebrook

SOCIETIES AND ACADEMIES. T ON DOM

Zoological Society, May 5 — Prof. Flower, C.B., F.R.S., President, in the chair, — The Secretary read a report on the additions that had been made to the Society's Menagerie during additions that had been made to the Society's Menagerie during the month of April 1891, and called special attention to the arrival of what appeared to be an adult male example of the Lesser Orang (Siman source) of Owen, presented by Commander Ernest Rason, R.N., who had olitaned it at Sarawak, and to a Great-billed Tern (Phathins magnirestry), obtained by purchase, new to the collection—Mr. Sclater opened a discussion Great-billed Tern (Phastheia magniretirs), obtained by purchase, new to the collection—Mr. Schare opened adnession on the fauns of Britash Central Africa, by politing out the institute of this new territor faul five, by politing out the limits of this new territor faul fryen immediately north of the Zamben and west of Lake Nyanas. Mr Schare gave an account of the principal authoristic that have already written on the single state of the principal authoristic that have already written on the single state of the single sta

Academy of Sciences, May 4—M. Duchartre in the chair—On the time of evaporation of water in boilers, by M Haton de la Gougulière. The author has mathematically determined the rate of lowering of the level of the water in ateam boilers of vanous forms—A geometrical theorem, by M. Tarry—On a class of ordinary linear differential equations, by M. —on a ciass of ordinary linear differential equations, by M Jules Cels —On the convergence of recurring simple fractions, by M. H. Padé.—On an induction inclination needle, by M. H. Wild. A short note is given on some manufacture. by M. H. Padé.—On an molection inclination needle, by M. H. Wild. A short note is give no none measure of magnetic inclination made with a new form of needle. It appears from the experiment that the molecation at a place can be electromed exceptionated that the molecation at a place can be electromed determined as contactly and columns of the electromed determined as contactly as declaration —On a process for constructing cerews mutable for the natruments to be used for the Contactly and the electromed as accurately as declaration—On a process for constructing cerews mutable for the natruments to be used for the Contactly of th together with analyses establishing their composition —

(1) 4ZnCl, HgCl, 10NH₁ + 2H₂O; (2) 2ZnCl, HgCl, 6NH₃ + ½H₂O; (3) C₃H₃NHHgCl; (4) C₄H₃NH₄ HgCl₂, (5) 5C₄H₃NH₄ GCl + 2HgCl₂; NO. 1124, VOL. 44]

(6) 3C₈H₈NHHgCl + 2HgCl₈; (7) C₈H₈ CH₉.NH₉, HgCl₈; (8) C₆H₈.CH₈.NH.HgCl

(7) C.H. C.H. N.H., HgC.I.)

A general by determining as a stimp of incition of the obsenical constitution of the constitution Génean de Lamarlière. It is shown that the anomaly which is observed in the inflated lateral roots of certain umbelliferous plants (Œnanthe, Carum) is more apparent than real. In plants of the same family an intermediate series should be found between the structure called normal and the structure of a normal inflated the structure called normal and the structure of a normal inflated root (Dascas, Apuni,—On the microscopic structure of the phosphate rocks of Dekms (Department of Constantine), by M. Bleicher. The rocks examined are said to show under the microscope the mixture of a fair proportion of custous division of the control of the production of custous divisions of the control of the production of dubties after.—Note on the Quaternary strata of Eragoy and Cergy (Senne-st-One), by M. E. Rivière.—On the production of dubties after the destruction of the pacternary by M. E. Hédon.—Meteorological observations on the Pannt, by M. Gulliamen Capus. An account is green of thermometric observations made between March 13 and April by 200 meteors. Europasia

ur Book Shell: Meyer, "Anleitung zur Bearbeitung meteorologischer Beobachtungen fur die Khmatologie" "Intensity Coils i how made and how used" Calleja. "General Physiology", ters to the Editor:— Co adaptation.—Prof. George J Romanes, F R.S.; Prof. R Meldols, F R.S. Physiological Selection and the Different Meanings given to the Term "Infertility"—Rev. John T. Gulick Letters to the Editor: Guilck Proplaino of Silk by Spidert.—S. E. Peal The Crowing of the Junje Cock.—S. E. Peal The Cowing of the Junje Cock.—S. E. Peal The Detruction of Fab by Frox.—F. F. Payne The Flying to Picces of a Whring Ring.—Charles A. Caria-Willian Hertz's Experiments. III. Hertz's Experiments. III. By Free Years' Pulse Curves. (With Disgrams.) By F. H. Perry Coate The Science Museum and Gallery of British Art at South Kensington Notes . The Iron and Steel Institute The Royal Society Sourle The Benue and the Kibbé. By Major Claude M.

University and Educational Intelligence Societies and Academies

Macdonald

CONTENTS.

PAGE

THURSDAY, MAY 21, 1891.

PYCNOGONIDS

Den Norske Nordhavs-Expedition, 1876-78. XX. Zoologi-Pycnogonidea. Ved G. O. Sars. Med 15 Plancher og I Kart (Christiania . Grondahl & Sons, Bogtrykkeri. 1801.)

Studies from the Biological Laboratory, Johns Hopkins
University, Baltimore. A Contribution to the
Embryology and Phylogeny of the Pycnogomids
By T. H.
Morgan. With Eight Plates. (Baltimore The Johns
Hopkins Press, 1851.)

THE group of sea spiders, or the Pycnogonidea, was for a long time among the least known, though by no means the least interesting, of the divisions of the marthe invertebrates. Linness described a species as a Phalangium, placing it among terrestrial forms, and though a century and a quarter has passed since then, the problem of where to place these Pycnogonids cannot be said to be finally settled.

Within the last ten years or so, an immense advance has been made in our knowledge of the morphology, anatomy, and embryology of the group, thanks to the labours of Anton Dohm, who, in 1831, described the forms found in the Gulf of Naples, and of Hoek, who about the same date described the species found during the cruses of the William Barents and the Challenger During all this period opinions varied as to whether these forms should be placed among the Arachinds or the Crustacea, but apparently both the authors just referred to have agreed that the Pycnogonids should be placed with neither, but that they, with the Anachinds and the Crustacea, have come down the stream of evolution in parallel lines

To the evisting recent memoirs of these Arthropods, the splendid volume just published on the Pyrongoindea found during the Norwegian North Atlantic Expedition, 1876–78, by Prof G. O. Sars, adds, perhaps, from a morphological point of view, the most important of the recent publications on the group, for, valuable as beyond question are the structural and developmental details, a special knowledge of general morphological details is also needed for the convenient understanding and classifying of any group

The maternal at Prof. Sart's disposal was very large, and in addition he has made use of collections made by himself during many years back on the coasts of Norway, and also of some few forms sent to him by Dr. A. Stuxberg, which had been found in the Kara Sea during Nordenselbid's expedition A very great contrast is to be seen on comparing these northern forms with such a collection as that of Dohm from the Mediterranean. The great number of species belonging to the family Nymphondies is specially characteristic of the Northern Seas as contrasted with the Mediterranean, while again the Northern Seas as contrasted with the Mediterranean, while again the Northern Seas as contrasted with the Mediterranean, while again the Northern Seas as contrasted with the Mediterranean, while again the Northern Seas as contrasted with the Mediterranean while for the Mediterranean while specially challenging the season of the Mediterranean of the Mediterranean while special properties of th

In working out the classification of the group, Sars has found it necessary to treat the families in a somewhat more for hardening; the eggs being cut in parafin.

restricted sense than has been done by most of the previous writers, and has been obliged to increase their number While fully agreeing that the descriptions and even figures of the Pycnogonids given by the earlier writers leave much to be desired, and are as a rule even exceedingly defective, in some cases indeed being so bad as not to be intelligible, yet he thinks that some quite recent describers have rejected as bad a greater number of descriptions than with a little patient research was really necessary. Thus he finds it hard to believe that, while not a few species have been described from the Gulf of Naples, all the species described as found there by Dohrn, with one exception, should be new. Most certainly as regards the northern species we cannot sufficiently admire the pains which Sars has taken in working out all the imperfect descriptions and rough figures of our past recorders of new forms, with the result that he has succeeded in re-establishing many wholly forgotten or ignored species of Goodsir and others,

As regards the terminology used in describing the various parts, some, classing the Pythogonids with the Crustacea, adopted terms in use among the latter; while others, holding their affinity to be with the Arachinds, employed again a different set of terms. Dohn, to avoid the difficulty as regards the limbs, rejects all special terms, describing them as No. 1, 11, &c, sar uses a terminology the terms of which involve as little as possible of any homologous references.

Forty-three species are described and figured. Several of them are here fully described for the first time, though short diagnoses of them appeared in a preliminary report The fourteen genera are arranged in eight families. and these are grouped into three orders, the ordinal characters being based on the relations of the "chelifors" Thus in Order 1. Achelata, these chelæ are, except in the larval state, entirely absent; in Order 2, Euchelata, the chelæ are well developed throughout all the stages of life; while in Order 3, Cryptochela, the chelæ are present, as a rule, in the young stages (not alone in the larvæ), but in the fully developed condition they become atrophied or disappear. This arrangement no doubt will have to be modified so as to fit it to receive the very numerous forms from other parts of the world, but it is a first step in the right direction of an intelligent grouping of the genera

The second memour on our list treats of the Pycnogonids from a different standpoint, being a contribution to our knowledge of the embryology and phylogeny of the group, by T. H. Morgan, Fellow of Johns Hopkins University After a short allusion to the work of Dohm and Hoek, who have "placed the morphology of the order on a very firm basis," he proceeds to treat of the early stages of the embryology of the Pycnogonids, stages which have been practically unexamined, and a knowledge of which is needed to enable the relationship of the group to be guessed at.

The material for this work was collected at Woods's Holl Three genera, each with a single species, are to be found at this place—Pallene emplusa, Phoxichithdium maxillars, and Tanysiyhum orbiculars, and during july. August, and September, these were found carrying ova The alcoholie picto-sulphunc acid process was adopted for hardening; the eggs being cut in paraffin. The

eggs of Pallens were large, 0.25 mm., and well adapted for investigation. After a munte description of the early stages of development, the author considers that from them there is little or no ground for a comparison between the Pycnogonids and the Crustacea, certainly not with any esting forms. The multipolar delamination of the endoderm in the Pycnogonids has no homologue amongst the Crustacea, nor is there any special similarity in the formations of the organs. There seems to be not race of gastridation hise that in the Crustacean in the ontogeny of the group. And if there be reason for rejecting a relationship between the Pantipola lava and the other properties of the properties of the properties of the other properties.

Nor are there any specual affinitives between the insects and Pyringonous's but between these latter and Peripatus as atriking similarity is met with in the paired ventral structure organs, both in the structure and position of these, but for the present there is no proof forthcoming as to a real homology of these bodies. The process of the formation of the endoderm, as described by Heider and by Wheeler in insects, shows a certain resemblance to multipolar in insects, shows a certain resemblance to multipolar form than is shown by the Pyringondis. With these two exceptions there would seem to be nothing else in common in the notice of the two groups.

Lastly, as to a decision as to the relationship with the Arachnids, or as to their being an independent phylum While Dohrn and Hoek ably maintain the latter, though not agreeing as to the why in all details, yet the study of the early stages of the embryology has brought to light certain facts which lead the author of this memoir to believe in a community of descent between the two-The reasons for this belief are given in full detail, with difficulty admitting of abbreviation. The Pycnogonids form the endoderm by a process of multipolar delamination, which is shown in its simplest form in Phoxichilidium and Tanystylum, and in a more modified condition in Pallene. In no other group of the Triploblastica is a similar phenomenon found except in the Arachnids In the spiders the process is not so well marked but it Balfour's conception of the formation of the yolk nuclei be correct, then a direct comparison may be made between the two groups. The first trace of the embryo to appear in Pallene is a round opaque area at the spot where the stomodæum invaginates. In Schimkewitsch's recent account of the development of the spiders, he shows that the primitive cumulus in them is the place where the stomodæum invaginates; and in calling attention to the fact that the stomodæum of spiders in its earliest development is a triangular invagination, he actually compares it with the triangular invagination of the exsophagus of the Pycnogonids. It is also exceedingly probable that the early formation of the body cavity surrounded by mesoblast in the legs of spiders has an exact parallel in Pallene and Phoxichildium. In both Arachnids and Pycnogonids there are wellmarked diverticula from the mid gut into the legs. In both Arachnids and Pycnogonids the first pair of appendages are chelate, and in both this first pair is innervated from the brain; these facts alone, it will be remembered, were considered by Balfour to indicate a relationship

between the groups. Mr. Morgan was unable to find any post-oral ganglia for Pallene, but the first pair of appendages arises on the sides of the stomodæum and moves forward later In this respect, it compares closely with the spiders, and the early innervation of this pair from the brain itself may be regarded as a more abbreviated condition than what was seen (by Balfour) in the spiders. Metchnikoff's figures for Chelifer show the first pair of appendages to arise above and on each side of the proboscis-like upper lip, and if future investigation verifies Metchnikoff's suggestion that this proboscis is homologous, entirely or in part, to the proboscis of the Pycnogonids, as his figure seems to indicate, then does the whole development of the Chelifer show remarkably close resemblances to that of the Pycnogonids pair of ambulatory legs-the seventh pair of appendages -has been a stumbling-block in the way of an Arachnid relationship, and the attempts to solve the difficulty have been many. Here, again, Balfour's suggestion that this last segment and its appendages may represent the first abdominal segment of the Arachnids is of value, as we know that the embryos of spiders have rudimentary appendages on the abdomen In a second part of this memoir the metamorphosis of Tanystylum is described. and in a third part we have a very complete study of the structure and development of the eyes of Pycnogonids and a comparison with the Arachnid simple eyes, a comparison that seems to verify the relationship pointed out E. P W. in the first part of the memoir.

A TEXT-BOOK OF CHEMISTRY BASED ON THE PERIODIC SYSTEM

A System of Inorganic Chemistry. By William Ramsay, Ph D, F R S. Pp. 700 (London: J. and A Churchill, 1891)

OURING the twenty-five years or so which have elapsed since the recognition of the periodic law of the chemical elements as a valid relationship, the pronounced influence which it has exercised both on the aspect and aims of chemical science cannot be questioned. Whether in the prediction of undiscovered elements, or as an indicator of needful research, especially in the department of atomic weight estimations, it has met with signal success In connecting the physical properties of the elements themselves and of their compounds with atomic weight, it has opened up new fields of investigation, and thrown fresh interest into old ones Properties so widely different as those measured by refraction equivalent and breaking stress find an explanation, nowadays, in the magnitudes of the atomic weights.

As a mean's of classification, too, the success of the periodic arrangement has not been less striking. Indeed, to its power as an instrument of classification it owes its general acceptance in the first instance. When the ideas of Avogadro had become recognized, and by their means the old system of "equivalents" had been replaced by the true atomic weights, then the periodic arrangement resulted in a grouping of the elements so much in harmony with existing notions of their relationships, that the far-reaching power of the generalization could no longer be resisted.

The distinguishing feature of the book before us consists in the use of the periodic arrangement as a means of classifying the subject matter of inorganic chemistry. Here, the time-honoured methods of putting the facts and theories of chemistry before the student are set aside, and as the method adopted is novel to English textbooks, it may be advisable to consider its characteristics. After a short historical introduction, the author proceeds to describe the occurrence, preparation, and properties of the elements in the order in which they are found in the periodic table. First, Group II, metals of the alkalin earths, and so forth The descriptions refer, as far as possible, to the elements of the same group taken collectively.

The compounds of elements of the different groups with the halogens form the next part, and in the introductory portion the student meets for the first time with matter which it is customary to discuss at an earlier stage in the text-books; such matter as the distinction between element and compound, the use of chemical symbols, the gaseous laws, &c. The fourth part deals with the oxides, sulphides, selendee, and clillurdes, and under these headings are to be found hydroxide, whydrosulphides, &c., classed as compounds of the oxides with water, hydrogen sulphide, &c. Here, also, are treated the salts of the oxyacids, classed as double oxides, and compounds with the halogens.

Part v gives an account of the borides, carbides, and sclicdes, such of the hydrocarbons as are considered, and the organo metallic compounds occur in this part Compounds with the elements of the nitrogen group, including the cyanides, form Part vi. Alloys and amalgams are discussed in Part vii. The first chapter of the next part gives a short account of spectrum analysis and the rare earths. The second chapter is chiefly concerned with the criteria for fixing atomic and molecular weights, the Raoulir methods finding a place, and the last chapter is devoted to the periodic law. The closing part of the book takes up, manly with regard to the chemical principles involved, the manufacturing processes usually texated in the text-books.

It will be seen, as the author states in his preface, that the method adopted does away with the distinction between metals and non-metals; no special stress is land on the properties of acids as contrasted with bases; equal prominence is given to tare and more common substances; and the commercial importance of a substance or process and the commercial magnitude of a substance or process is not considered an argument for its special considera-

Such a work as this may be looked at from two points of view. Regarded as a systematic arrangement of the facts of inorganic chemistry, from which any desired information may be speedily taken after one has become a similarized with the method of classification adopted, its success is undoubted. The book is quite in touch with recent investigations, nothing of importance seems to be omitted from the descriptive portion, and, what is a recommendation to a large class of readers, the size of the book is not excessive. Whatever be the results of the system adopted, economy of space is assuredly deheved.

To the teacher or to the advanced student who wishes to use the book as a work of reference, or desires to

systematize his knowledge, it will be eminently useful. If, on the other hand, the system be regarded from the point of view of a basis for teaching, its construction from its very novelty must be open to discussion A method of teaching chemistry often employed may be said to consist in giving the learner in as easy a manner as possible the leading facts of chemical science with regard, in the first instance, more to the correct appreciation of the meaning of the facts themselves, than of the exact arrangement or classification of the same. To this end the student is led from the study of the chemical properties of commonly occurring bodies to the description of the elements contained in them, explanations of chemical terms being given as they crop up, or in short reviews at intervals not far apart. When the properties of the elements are being explained, their reactions with other elements have to be noticed, and hence it appears natural to describe the important compounds of an element after its own properties have been discussed The periodic system does not seem to provide the means for such a course of teaching, and this appears to us to be the main reason for its non-adoption in the text-

Indeed, the new method has little in common with that indicated above The entire series of the elements apart from their compounds are described, and chemical and physical terms are freely used without any attempt being made to define them till all the elements have been treated In fact, a few terms, as critical point and heat of formation, are used, but as far as we can see, not defined in the book Again, compounds containing a common constituent are classed together, but compounds of what may be taken as a parent element are scattered throughout the various groups Surely, in connection with this point, reasons similar to those which lead to the grouping of compounds containing the same element, on the new system, would hold for the old method of considering compounds. The position of the tron group of elements after the aluminium group and of the copper group-the last one described-may be taken as an indication that even in the author's opinion the periodic law does not in all cases indicate most clearly the relationships of the elements Such considerations as these must weigh with a teacher before he can adopt the system : during four years' experience, however, the author has had no reason to doubt its success.

The book is clearly printed, and the illustrations, though not very numerous, are for the most part new. The frequent use of vapour jackets in the apparatus represented is suggestive of the author's more recent contributions to scientific literature. The useful system adopted by Ostwald in his "Lehrbuch," of indicating the state of aggregation of a substance by the type, has been employed.

Setting aside the points which may be urged against the work as a basis for teaching, the penodic law, as expounded by Prof. Ramsay, does more than any other system of classification to put the matter of inorganic chemistry on a footing resembling that which holds for organic chemistry.

OUR BOOK SHELF

Eighteen Years of University Extension By R D. Roberts, M A. D Sc (Lond.), (Cambridge University Press. 1801)

THE University Extension movement takes so prominent a place among the educational influences of the age that a good account of the system has for some time been needed. This is supplied by Mr Roberts, who, first as needed. This is supplied by Mr. Roberts, who, first as lecturer, then since 1881 as assistant and organizing secretary to the Cambridge Syndicate, and since 1886 as secretary to the London Society, has had the best possible opportunities of studying the new method, and of forming a judgment as to its fitness for the uses to which it is He begins with an account of the origin and growth of the movement, then describes the character of the audiences, the reception of the idea by artisans, and the signs of earnestness displayed by various classes of students. Mr. Roberts also discusses the conditions of success, has a chapter on the consolidation of the work, and presents a summary of results. No essential fact be left on the minds of most readers probably is that those connected with the movement have done much to foster and to satisfy the desire of a very large number of persons for intellectual training. There are certain rules—some of them rather difficult—with which the system must be brought into accord if it is to be capable of further development; and these are stated with much force and precision in the present useful little volume

Evening Work for Amateur Photographers By T C. Hepworth, F.C S (London, Hazell, Watson, and Viney, Ltd, 1890)

In this book the author has written, in an interesting manner, a series of chapters relating to many points in photography that are generally found most useful to amateurs following are the subjects of some of the chapters. lantern entertainments, lantern-slides on gelatine plates, clouds in lantern pictures, frame-making, enlarging, photography by magnesium light. There are also two or three chapters on electric light, light by incandescence, and methods of making cheap batteries

The subjects are treated in a manner that makes the book well worth reading, and its value is increased by numerous illustrations obtained from photographs and

drawings by the author

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions ex-pressed by his correspondents. Neither can he undertake to seturn, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications?

The University of London Question.

THE Convocation of the University of London has, by a large majority, thrown out the scheme for the reconstitution of the University proposed by the Senate. Even those who had little

University proposed by the Sanate. Even those who had httle love for it must feel some sympathy at the furnitation of labours love for the moment the whole question remains in absystace. For the moment the whole question remains in absystace. If modificated to think that it may be useful to discuss, in the interval which must clapse before any further step is taken, some of the fundamental questions which seem to me to underlie the

of the fundamental questions which seem to me to underlie the solution of the problem, and have never, as it seems to me, been groperly considered.

Od'shich a subject one might easily write a great deal. For the sake of brevity I shall therefore attempt to sum up what I have to fix under separate heads.

The Examination System,

One factor in the present situation is undoubtedly the growing dissatisfaction of many distinguished teachers with the examin

tion system as applied to University education. And as the University of London at present does nothing but examine, it is obvious that the question lies at the root of any padgment that move that the custom of the state of th experience, and to teach the conventional and commonplace.

I am free to admit that there is a certain element of truth in what Prof Lankester say. But having had, like him, a good deal of experience both of examining and of being examined, I area of experience out of examining and of being examined, I am disposed to think the picture somewhat over-coloured. No doubt the University of London in the past has exalted examination into a sort of idol. But as regards the superior degrees in science and medicine, at any rate, examination is now practically dispensed with, and the lest of competence is the performance of some kind of original investigation. For the inferior degrees, as far as I am aware, the examina-

For the inferior degrees, as far as I am aware, the examina-tion system in more or less presentible subjects obtain every-where in the three lengthons. For my part, I think the system may be defended, and upon the same lines as those on which the many better than the system of the state of the For he says, and I think rightly, that such an examination 'may be regarded as a means of criticing and testing the performance not merely of the schoolboys but of the school-mancer." Now an University desicning as curried on in this masters." Now in University education, as carried on in this country, I can only see a prolongation of school education, with methods and a moral discipline modified to suit the more admemory and a norm discipline meaned to suff the diore advanced age of the pupils. And the inferior degree (I am not speaking, of course, of professional subjects) is, in my view, nothing more than the corresponding "leaving examination" It is a test of whether teaching has been faithfully done and learning diligently pursued

I am quite ready to admit that impending examinations are more or less irksome both to teachers and taught, but I am not convinced that that discipline is in itself an evil. It is not undesirable that some restraint should be put on the possible vagaries of the one and the very probable desultoriness of the vagants of the one and the very promote destitoriness of the other. It is necessary in entering upon the study of a subject to go over its fundamental groundwork in a methodical manner. To many teachers and to many pupils this is not a little dull. It is easy and it is pleasant to dwell at some length on attractive. parts of a subject and to skim superficially over others There are probably few persons who, looking back upon their own student days, will not admit the truth of this The fact is that student days, with not admit the trust of the letter is grammar; and the majority of young people require some degree of compulsion to make them do it. It may be likeome at the time, but the advantage is life-long. I know, speaking from my own experience, that the compulsion of schedules which is so odious to Prof Lankester has made me devote my energies to the to Prof. Lankeater has 'made me devote my energies to the mastery of the rudiments at any rate of many subjects which I should certainly have carefully avoided if I had not been commercially avoided in the carefully avoided in the carefully avoided in the lands of competent examiners. But then I agree with Prof. Lankeiter that the examiners must know their business, and must not be either ill-informed or pedantic. No one, I have, earning that the kind of men that the University of London enhants in its service as examiners are open to the charge of being either.

If these views are correct, and I believe in the main they are, then the evil consists not in the examination system as the inthen the evil consists not in the examination system as the in-centive to the orderly performance of a curriculum, but in standing an experience of the control of the control of the which the custed world statches to acidemic achievement. "A man refers throughout his life to the fact that he obtained a first-class is a sort of perpectual estimatiat." Of corne, in so first-class is a sort of perpectual estimational. "Of corne, in so study in a means, not an end , it is a sort of appreculocably to a study in a means, not an end , it is a sort of appreculocably to a subject. The situent learns it technique, its larguage, and something of its literature. If he has done this extractly and well, his Driversury will applied him, will call him in accidental

NO. 1125, VOL. 447 '

language "a good boy." But when the congrutation of inringuish has subsoited, the real question arise, what will be dowith the tools he has learn to use? Here, I think, University work catters upon a new phase, and one, it seems to me, too little regarded—I mean port graduate study. To control this in any measure by means of cummation seems to me in the highest investigation, at any rate for its doctorate of scenee, the qualification for that degree, the University of Landon has taken a step in advance of many of the older Universities towards destroying the control of the contr

A Teaching University.

I have always found it not a little difficult to understand what those people exactly mean who to retransuisty demand at eaching University for London. What Frof Lankester means, there is the control of the property of the control of the control

Froit. Lankester adopts the wave of Fichle, who says "that property and the property of the pr

While I cannot help thinking that those who advocate the creation of a so called teaching University in London, have got hold of an idea which they have only imperfectly assimilated, it is still worth while to examine some of the ways in which it might be realized.

In with a readjourner and the second of the country of the country

NO. 1125, VOL. 44

personal contact he can have with his pupils, till at last he has to rely for any infense at all on the atimulus of lecture-room oratory. As Mrs., Garrett-Anderson, has, it seems to me, correctly pointed out in the Thurst, three as very little really to the said in favour of anything like a great central teaching institution for such a city as London.

for such a city as Loudon. The other alternative Incombine University and King's The other alternative Incombine University and King's The other alternative Incombine University and the regarded sea in any way, a statement his proposed with the season of the university of of the university

Furthermore, it is quite a mutake to suppose that unless the extenting University at abulhed, it will be possible for a younger one to caspe its influence. Notwithstanding the establishment of the Victoria University, it is still found necessary, and at the request of Ovens College, to hold the examinations of the University of London in Manchester Consequently, the professor of Ovens College have to adapt their teaching to a double curriculum. If the proposed University of Westimuster and the College of the Co

Expansion of Existing University

It may be taken as quite certain that the existing University of London is too well rooted in the eateen of the community to be got rid of Nor, with this own consent, will it restlyly submit to be mutilated or themembered. And its prise and confidence can brailly be denied that it has accomplished a great work it may be considered to the control of acceleration. This need not be wondered at, seeing that it has always unceredint in entiting in its service the most accomplished and considered to the control of acceleration. It extraordinates the confidence of the co

Instead of typing to dramats and currial the welfathous of an Instead of typing to dramats and currial the welfathous of an Instead of typing to dramats and currial the welfathous of public particular, and the profession of the property of the profession of the provided of the provided to the provided

I will briefly indicate the by no means drastic changes by which this might be gradually provided for.

Organization of the Faculties

I am systl personally impressed with the conviction that the first several personally impressed with the conviction that the first several personal properties of the first several personal per

felt that this is a great evil. Examination is an art, and it is a progressive art. To minimize its possible harmfulness it should keep touch with the teaching. And it must be admitted that keep touch with the teaching. And it must be affinited that the system which now obtains at the University of London does not make this always easy. The Senate is hard to move and slow to act. This would not be so if those who had the right to move it possessed the momentum which would be derived from a more obvious authority. In fact this teacher, to traction arises from a natural Ulmdity. The Senate is too largely composed of persons who have no direct touch with actual

The momentum to which I have referred above would con with all needful force from the faculties if they were organized an a comprehensive way to include every competent authority in academic education in London. I will not stop to discuss the precise machinery by which this should be brought about It seems to me that it would be probably sufficient if the Senate seems to me that it would be probably sufficient if the Senate were to have power to admit to the facultuse the teachers of all institutions of academic rank which supplied it with candidates. To these should be added the past and present examiners, a certain number of non graduates conspicuous for their distinction in the subjects with which the faculty was occupied, and a proper proportion of members of Convocation

Such a body would occupy itself with any and every subject relating to academic education. Its resolutions would embody the deliberate conviction of iastructed and competent persons, and would afford the Senate a solid basis for administrative and would afford the Senate a solid basis for administrative procedure. I need hardly say that the faculties—if they took, as I doubt not they would do, a just view of their functions—would look to the advance of academic interests as whole; they would not seek the sole advantage of the central University, but would which and work for the interests of the collegate institutions they represented—whether in London or the provinces—as well.

Boards of Studies

Delegations from the faculties should be intrusted with the duty of watching the examination work and advising the Senate thereupon. This they would do in two ways (1) they would thereupon. This they would do in two ways (i) they would consider from time to time all alterations necessary in the schedules to as to keep the examinations as closely as possible in did to the control of the contro rejections

Reform of the Senate.

I think it is generally admitted that the time has come when some change in the constitution of the Senate is advisable. At present it is an assembly of notables appointed for life. Many of them never attend, and some, appointed apparently on purely ot them never attend, and some, appointed apparently on purely oplicited grounds—and these are not always the least competent —never perhaps have attended. On the whole, the Seminor though Individually seminent, is, it must be confessed, ill informed on educational mattern. As I have already binted, it is a place to consequence to be somewhat tund and irresolute when it ought to act with decision, it is equally api, I am afraid, to act with the control of the control of moving precipilizary when it ultimately realizes the necessary of moving at all.

The Senate must, however, remain the supreme governing body with whom the final decision must always remain in matters of importance. This being so, it seems not too much mauters on importance
Into Design 80, it seems not too much to ask that it should be an efficiently constituted body, and that the members should attend to their duties. Tenure of office for life it would seem desirable to abolish, and prolonged absence from attendance, say for a year, should type factor vacate a seat. As for the Crown nominees, who are in great part statemen of high rank, it would be on obvious grounds unwise to dispense with them, if they took, as many of them do, sufficient interest in the work to attend with some regularity. Where the Senate in the work to attend with some regularity. Where the Senate needs strengthening is in experts in academic education, and it appears to me that the faculties, if constituted as above, might be intrusted with the duty of selecting these members of the Senate from their own ranks On the whole, it might be convenient to constitute the Senate something on the lines of the Heb-domadal Council at Oxford, a third to be appointed by the Crown, a third to be appointed by the faculties, and a third by Convocation.

NO. 1125, VOL. 44]

Higher Teaching.

There is still, however, one direction in which the University of London might even more closely associate itself with actual This was pointed out in 1872 by the late Registrar, Dr. Carpenier, in his evidence before the Royal Commission on Scientific Instruction. He said (Minutes of Evidence, 10,925), "I think it very important that the State should provide for the "I think it very important that the State should provide for the carrying on of those higher researches, and that higher teaching, which are not provided for in any shape at present." Again (10,926), "I think that a body like the University of London (16,920). "I think that a body like the University of London inglit very advantageously be empowered to take up such higher and more special teaching. At present the University of London has nothing to do with teaching The principle of the University is to recognize existing institutions." I do not think that it would be at all the function of the University to interfere that it would be at all the function of the University to interfere or compete in any way with the institutions which it recognites But I should myself be very glad to see the University and the properties of the properties affiliated to it." The copy of this higher teaching was brought out more clearly in a subsequent part of Dr. Carpenter's evidence in answer to a question of Prof. Henry Smith, (0.953) He anded, "The Senate might at one future time endeavour, might they not, to have such lectures given in connection with the University of Lunglon as are now greef in

connection with the University of Lendon as are now given in the Collège de France's—Ven, more of that character, why provided the Collège de France's—Ven, more of the character, why provided the Collège de Co lectual life of London

It is just possible that it may be objected that the proposal to have a superior professoriate attached to the University is in some degree a slight on the Colleges and their teachers. And it some edgree is upon to the concepts and men leachers. Find in may be urged that, if there were any demand for post; graduate teaching, the Colleges are quite competent to provide it in may be so, but in practice I do not believe it feasible. The working day is inelastic, and from what I myself know of the labour involved in what may be called systematic graduation. sahour involved in what may be caused systematic graduation courses, I do not believe that the same man can superadd hhe higher work as well. Besides, to be of any value, it must not be formal and perfunctory, the essence of the higher teaching is that it should reflect the research to which the occupant of each chair should be able to devote the whole of his time

each char should be able to devote the whote of his time de as, at I do not think that such professorships will be founded. For his and other reasons I about gladly see the University cease to be a quast-Ooverment ministrieu, and launch out on its own resources. It seems almost incredible, but it is a fact, that at the present time not the "slightest alteration can be made in a schedule without the approval of the Home Office, or the slightest alteration in the amount of prizes without that of the signess atteration in the amount of prizes without that of Treasury. There is no inducement now to the public to pro-vide endowments, because, as the University nearly pays its way any public been faction would only tend to create a surplus, which would have to be paid over to the Exchequer. But I can hardly doubt that if the University were cut admit from the State it doubt that if the University were cut admit from the State it would receive endowments which would enable it from time to time to found useful and important chairs. These would form not an unwelcome addition to the too few prizes accessible to those who devote themselves to learning for its own sake.

those who devote themselves to learning for its own take.

I had it in my mind to any a few words about the very complicated but independent problem which medical University to the problem which medical University to an indicarble length, and the subject is perhaps of limited interest to the readers of NATUKE But I may say that I believe that the organization of a strong medical faculty would bring about the solution of all existing difficulties.

ROWAL Gardonn Key, May 18, W. T. Hithstron DYER.

Royal Gardens, Kew, May 18.

A NOTE in the last issue of NATURE (p. 39) seems to assume that the present University of London is nothing but an Imperial Examining Board that has got wrongly named, and stands in the

way of London possessing the educational advantages of a German University town
I venture to offer some facts and considerations which may

nodify this view, and perhaps aid in forming a juster conception of the real nature of the University question than is commonly entertoined

Much more important matters are involved in the question than the maintenance or extension of existing institutions, though these are quite legitimate subjects of discussion and defrozen the columns of NATURE it is only upon the broad ground of the advancement of science and learning that the

ground of the advancement of science and vacating time are question can be dealt with The epithet "Imperial" is intended to imply some unitiness on the part of the present University for other than "Imperial" functions, whatever these may be. But the University has not, and never has had, the lesst claim to any such title. It has never at any time held columnal examinations of its own motion It has never at any time held any colonial examinations whatat this never at any time next any Cotonia examinations what-ever in the faculty of science, or in the faculty of medicine, or for honours in any faculty, or for any of the higher degrees What examinations it holds in any colony are held only at the request of the Governor of the colony, transmitted through the Colonial Office, and are practically confined to matriculation and the intermediate examination in arts Occasionally, but very rarely, an examination in laws or for the Bachelor of Arts is held in some colony. In 1850, 16 cendidates materialised in the colonies, and 5 pussed the intermediate examination in aits out of a total of some 5000 candivites. Not a single degree examination was beld in any col only. In fact, these colonial examinations, which, few as they are, pearly disminish in sumber, and the colony of the colony of the colony of the colony of Mauritius, but were extended and have been maintained about 1864, at the requised of the colony of Mauritius, but were extended and have been maintained chelly to facilitate the swarf of the ecolonistic at the colony of the colon of the colony of the colony of the colon of the colony of the colon of the colony of the colon of the colony of th held in some colony. In 1860, 16 candidates matriculated in the

gene mouthly choint roun minuma data content regional and appears are now drawn from an area harmy London for its centre with a radius of not more than 100 mile. The probable establishment, at no very remote period, of provincial Universities will practically give a still more exclusive sense to the nance University give a still more exclusive sense to the nance University give a still more exclusive sense to the nance University in and for London. The creation of which is constantly pair forward as the principal educational need of the metropolis. Is the proposed University to the "for" London Confond, or that of Editable the New York of the Confordon of the Statistical Con

intended to impose focal limitations which no University his every ext imposed upon itself.

The expression "teaching University," too, stands in need of acated definition. The University of Edinburgh is a teaching Carteria of the Carteri University of London would be the examination of collegiate University of London would be the examination of collegates candidates and those only by their teachers in alleged conformity with the principle that examination should follow teaching. But it may be admirted that teaching ought to be adapted to examination, or examination to teaching, without admired that teachers settling the manufacture of the state o mixing any advantage in the system of reachers setting the examination of their own students, collegiate or not. The combined teacher examiner system is not wholly trusted by its supporters. At the older Universities the examiners are by no

means usually the teachers of the candidates, at the Victora University one of the examiners is always an "external Section Annotation and the section of the candidate and the section and th London?

Further, is it not misleading to characterize the University of Further, is it not misleating to characterize the university of London as a mere Examining Bard? Of the three fanctions of such a teaching University as that of Edinburgh, it performs two It directs teaching by yillabuses and regulations (pre-pared with extreme care, and not without ample reference to the best authorities on all matters of special knowledge), and it tests teaching by absolutely impartial and disinterested examina-tions, but it does not-without space, funds, and appliances it tions, but it does not—without space, funds, and appliances it could not—pretend to teach. Nothing, however, in its nature or essence forhids its development, alone or in union or conjunction with other institution, into what would be an ideal University of the non residential order, neither coercive nor exclusive—one that should offer proper University instruction. to all comers, and, at the same time, confer degrees upon open examinations independently (save for obvious reasons in relation

examinations inageneously (see for obvious reasons in reasons to medical degrees) of place or mode of instruction the part the existing University of London has played in the advancement of learning may be indicated by the fact men-tioned by the Vice-Chancellor in his Presentation speech, that during the last thirty years—that its, since its examination, were suring, ne fast turry pears—that it, since its examinations were thrown open—the number of degrees conferred by the University has increased tenfold. This, however, is only one of the ways in which its influence is shown, the great advance in scientific education the last fifty years have witnessed is almost wholly due to the stimulus and example of the University of But the subject is too large a one to be dealt with on the present occasion, and indeed, from its nature, scarcely lends itself to treatment capable of doing full justice to the University. The work of a University should not be confined to the edu-

The work of a University should not be confined to the edu-cation of graduates. Hs crowning function is the exposition and illustration of the higher learning along the whole line of dwance. Such is the task so admirably accomplished by the Surhonne and the Collège de France, and to the world of science and learning in London the University of London is peculiarly well adapted, by its independence and impartiality, to render similar services Some years ago an attempt was made to work similar services—Some years ago an alternit was mane to work as cheme having this end in view, but, in deference to reason, that no longer exist, it was found necessary to abandon its further provecution. Its resumption has now become, or may shortly become, simply a question of means, and the time is at hand when a strong effort ought to be made to afford scholars. and men of science in London some of the advantages their and men of science in London Paris.
brethren have so long enjoyed in Paris.
F, Victor Dickins

Co-adaptation

WRITTEN letters remain. It is for anyone who may read this correspondence through at one time to judge on which side lie the "valid" distinctions, and on which the "invalid" con-fusions—not to mention comparisons in respect of "verbiage" or fauson--not to mention companions; in respect of "rerbinge" or more personaismes. But I am obliged to write one more to inside, for the fourth time, that my agreement with Prof. Mid-of co adaptation," but only to stating that co adaptation must be proved not to exist, if "Mr. Spencer's argument" is to be logically met. And if, as Prof. Meddol now say, any vach statement to be found in his "review of Mr. Pancoc's book." (which, A repeat, mercy reproduces "Ant. Valence's argument as to the decommission of adaptations, without remarking that this has no relevancy to the argument from co-adaptation), at must be in that "language of their own" which the neo-Darwinians find "to be intelligible among themselves."

Christ Cherch, Oxford, May 15. GROKEN J. ROMANES.

A priori Reasoning.

I SEEM to have failed to make my contention clear to Mr. Cockerell, and will try once more. What I maintain is this:

that it is unscentific—unphilosophical—to gate an hypothesis or formulate a theory, and much more as to make a categorical or formulate a theory, and much more as to make a categorical verification at tempted. Thus, Mr. Cockerell task the question, "Why is it that plants growing on exposed sea-thores have a tendency to the upon the ground or otherwise is enade the tendency to the upon the ground or otherwise the sender labe too bring forward that the purpose of lying down as to evide the volence of the winds? So far, it is nothing more than has private opision—an a preser assumption. It is true that he adds a reason, but it is an demay more than has private opision—and preserva assumption. It is true that he adds a reason, but it is an demay more than its order to the sort consolences, and not from nature . "When a plant is growing among others, it has to compete with them in raising itself into conspicuoushas to compete with them in raising itself into conspicuous-ness." But do not dwarf plants ever compete? My experience of the South Downs, where plants are for the most part con-siderably dwarfed, is that the struggle between them is a severe one. Yet their flowers and foliage are fully exposed. severe one ret their nowers and tollings are unit exposed to sunlight and insects, as well as to severe gales of wind. Mr. Cockerell also appears to forget that what is true for one plant is true for another, and each must try to overtop all the others.

I would venture to warm our younger naturalists most ear-nestly against this facilis descensis of a priors reasoning with-out facts or verification. It has been the baine of metaphysics; and when a scientific man like Dr. Weismann puts forth, in the name of science, most deplorable illustrations of it in his late attempt to apply his theory to plants, it is time that some one should venture to protest

one should wenture to protest
In reply to his request, it would refer Mr. Cockerell to M.
Verlot's pamphlet "Sur is Production et la Fixation des
Varides," in which he describes his method of creating and
fixing dwarf plants by sowing seed late in the season. Also to
M. Rosjou's experiments in electing the smallest seeds of
plants (Fourn d'Hist Not de Bordeaux et du Sud-Ouest,
1854). Mr. Mohab also raused dwarf Hodedendons by using pollen from the smallest stamens Want of space forbids me adding more on the subsect. Gronge Henslow. adding more on the subject.

The Natural Selection of Indian Corn,

In a former letter I had occasion to mention that Zea mais varies in its period of maturing, and that at certain altitudes and latitudes, only some of the varieties (s c. the early maturing) are able to mature at all, the rest being absolutely eliminated by natural selection in a single generation. A few days ago I received, through the kindness of Mr James Fletcher, the new (1891) Report on Experimental Farms for 1890, published by the Canadian Government, in which are numerous statistics of experimental planting in different parts of the Dominion. On p. 296, Mr. T. A. Sharpe gives an account of the result of planting twenty-nine different varieties of Indian corn at Agassiz, British Columbia, which perhaps deserves notice, as illustrating the above-mentioned facts in a particularly clear way. Of the varieties planted (all exposed to the same kind of environment), the majority did not form any ears at ail. Some formed very small ears, and others reached various stages of maturity, but only a very few actually matured.

For example, I will quote some of them -

No. 1. Moore's Early Concord, corn matured, one of the

best. 3 Early Adams, corn matured to glaring stage.
6. Mitchell's Extra Early White Flint, produced some

matured ears.

No. 11. Marblehead Sugar, matured corn, ears very small.
No. 12. Narraganset, aweet, corn did not fill to tips of cob.
No. 14. Chester Co. Mammoth, no corn formed
No. 21. Golden Dent, no ears formed.

T. D. A COCKERELL. 3 Fairfax Road, Bedford Park, Chiswick, W., May 10.

The Soaring of Birds

IT seems a great paty that the simpler form of this questionwherein birds soaring steadily rise, in a gentle breeze, over a large plain—is needlessly complicated by the flight of sea birds

over waves
we shall get the solution best by taking the former and less
ownplicated case, wherein the pelicans, adjutants, cyrus, vultures, &c., stody see, by soaring alone, to great heights, under
conditions where up-rushes of air are quite out of the question.

Upper Asam is a dead level, aoue 60 miles wide by 200 long, and over this area, wherein these birds rise by soaring alone, the alt-offit is almost nuvariably from north-north-east, or else south west, and at about 5 to 10 miles an hour. They do not seem to rise in a dead calin, nor yet in stormy weather, and I take it the desideratum is a slow art-offit, or gentle standy.

breeze. That there are no up-rushes of air, I have fairly good proof in the small tufts of cotton, from the Bombys: melabaricum, which cross the field of my telescope when examining the Noga Hills at 10 to 20 or 30 miles; these are always beautifully horizontal at elevations from 200 to 2000 feet, coming from the plains and

hills north-east of us. So that out here there is no complication of the case by verso that out neer there is no complication of the case of year tical movements of the air, as at sea. The question is not how large birds sustain themselves (without flapping their wings) in a wind, when there are rising and failing and sixtato "different velocities"; but how large birds like the cyrus, adjutant, pel-can, and wilture can rise from 300 to 3000 feet, in a **idedy*

breeze, without flapping their wings
It is not mere floiation, they have to raise 20 or 30 pounds
some 2000 feet, in addition to what the albatross does.

Surely this is the major question, at once simpler to see, and more difficult to answer

In NATURE (vol. xxiii p. 10) I drew attention to this, and sent a small diagram, to show how I thought it was done. I have frequently observed the phenomena since, and see no reason to modify my view

reason to modify my views.

Firstly, these large brids on me sear in a dead calm, or a
Firstly, these large brids.

They prefer a stansfty recommendation of the control of the control

Secondly, they rise from the ground, by flaspung the wings, and continue this till they are 100 or 200 feet up, and the begint to soar, in right or left hand spirals, 100 or 200 yards across, At each lag help rise 100 or 200 feet, and make as many yards leeway, drifting slowly routh the wind, and continue thus to rise until out of sight above.

With a good telescope a bird can be easily followed after a little practice, and the only motion which can be seen is slight and occasional movement of the tail, in sleering.

The legs (of the waders) are extended at full length behind, the neck thrown on the back, and beak projecting over the



feathers are always well separated in different planes.

evidently under great strain evidently under great strain.

The lifting power is evidently applied to them mainly, and the plane of the outspread wings is not horizontal, but forms part of an obtuse, inverted cone, as though a little centrifugal force was implicated.

The speed of the bird is always greater than the breeze, and the resistance is unequal on opposite sides of the loop of the spiral; least when it travels with the breeze, and greatest when on the opposite half, meeting it

on the opposite mai, meeting it.
It seems to me the solution is that, when going with the wind,
the bird gathers momentum by going down a slight incline, and
when it turns and meets the breeze, the extra momentum is
used in lifting the bird and extrying it over a Moritr course.
Thus it sterts the next lap at a MgMiD higher level, but some 20

Thus it stars the next lap at a n/ga/h/ higher level, but some so yeard to leawers. Variation of the speed of the wind at different levels is here quite out of the question; the bard, too, keeps to level in here quite out of the question; the bard, too, keeps to level in the profit profit

ON SOME POINTS IN THE EARLY HISTORY OF ASTRONOMY!

HI.

WE now come to the important point for our present inquiry—the direction in which the temple is built, or, technically, its orientation. Confining ourselves for the moment to Karnak, is there any meaning in the direction of that line, some 500 yards long, which is obviously the main feature of the building, and to which all parts are accessories?

How can we instrumentally determine this? I have the necessary apparatus here, and the question may be answered in a few minutes, we have simply to determine either the aimuth or the amplitude (and as we have seen one of these gives the other) of the point of the hormon towards which this long line is directed

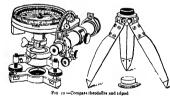
The azimuth compass is an instrument familiar to most of you. It consists of a magnetic needle fastened



Fig. 17 —Azimuth compass. sv, direction pointer, 11, sun shade (for observations of sun), 1, reading prior, A B, graduated card with attached

to a card carrying a circle divided into 360°, which can be conveniently read by a prism when the instrument is turned toward any definite direction marked by a vertical

A theodolite armed with a delicately hung magnetic needle which can be rotated on a vertical axis will do equally well, it has first of all to be levelled, there is a little telescope with which we can see along the line



When we wish, for instance, to observe the amplitude of a temple, the theodolite is set up on its triped in such a position that we can look along the temple wall or line of columns, &c., by means of the telescope. We then get a magnetic reading of the direction, after having unchamped the compass; the compass showing the angle made between the line and the magnetic north (or south), as in the azimuth compass.

Having made such an observation as that I have de-

NO. 1125, VOL. 44]

scribed, the next thing we have to do is to determine astronomically the real north, which is the only thing of value. There are two ways of getting this astronomical bearing or azimuth

It is sad to think how much time has been lost in the investigation of a great many of these questions, for the reason that the observations were made only with reference to the magnetic north, which is vastly different at different places, and is always varying; few indeed have timed to get at the astronomical conditions of the problem. Had this been done either by the French or Prussian Commissions to which I have referred, it is perfectly certain that years ago the solitical orientation of Karnak and other temples which I shall have to demonstrate to

you would have been long known to all scholars If the magnetic varation has been determined for the region we may use a map. Such a map as that shown in Fig 13 gives us the lines along which in the Bristh lists the compass variation west of north reaches certain values would along a line extending from a little to the west of Cairo to the second cataract would have had a variation of 12° to the west, in 1844 of 8° to the west; and at the present time the variation is such that observations made along the same part of the Nite valley will have a variation closely approximating 5° to the west. By mean such such a map it is guite possible to get approximately the such an approximation of the such such such that the such such such which can be observed in the present day.

If we are not fortunate enough to possess such a map, the theodolite will enable us to observe the direction in which the sun culminates at noon. This gives us the south point astronomically From observations of the pole star at night, the astronomical north can be determined. From either of these observations the magnetic variation is obtained without any difficulty variation is obtained without any difficulty.

This being penised about the melhod, we next come the results. The melhot was the results of the plants of the control of the control of the plants of the control of the control of the plants of the plants is 50° N; of W, which we learn from the table already given is precisely the amplitude of the place of sunset at the summer solution. The amplitude of the point to which the axis of the small temple points is 26° S; of E, exactly the position of sunnies at the winter solution.

There is more evidence of this kind Abydos, one of the oldest temples in Egypt, built, according to tradition, by the servants of Hor, is now, its true, a heap of ruins, the brick walls best showing its direction; but it is possible to the showing its direction; but it is possible to the solid properties of the prope

At Alydos, then, as at Karnak, we get exactly, within a degree, the amplitude shown in the tables for the sun in the Nile valley at sunset at the summer solstice. So that the Egyptians who were employed in building those temples must have known exactly what they were going to do, and what they did was to-build a temple such that the sun at setting should, at the summer solstice, pour its light along the axis of the temple I Maspéro and the great

authorities in Egyptian archeology are right-mainty, that the Allydos temple was founded before 4,000 nC — and if we can depend upon the French figures, we are driven to the conclusion that we have in this temple a building which was orientated to the solitutial sunset place in the valley of the Nile. The Nile valley holds other solar temples besides those we have named, but it is best to fully study Karnaki; instead of being a mere beap, the orientation of which is obtainable only by the general lie of the remains, thus temple is still in such

preservation that the Germans, in the year 1844 could give us an infinite number of details about 14, and locate the position of the innumerable courts. Its orientation to the iolatice we can claim as an early astronomical observation. So its quite fair to say that, many thousand observation. So its quite fair to say that, many thousand it events, the Egyptians were perfectly exam got at all events, the Egyptians were perfectly fully with the yearly path of the sun.
But so far we have only dealt with solutions: Did

But so far we have only dealt with solutions. Did the Egyptians know anything about the equinoses? Certainly Nothing is more remarkable than to go from the description and the plans of such temples as we have seen at Abydos and Karnak to regions where, apparently, the thought is totally and completely different, such as we find on the Fyramid Plains at Chitek, the orientation of the control of the control of the control openion, that these structures are just as true to the sun-rising at the equinoses as the temples at Abydos and Karnak were to the sun-rising and setting at the solutions,



Fig. 13 -Map of British Isles showing the magnetic variation 1

and the Sphinx was merely a mysterious nondescript sort of thing which was there watching for the rising of the sun at an equinox, as the Colossi of the plain at Thebes were watching for the rising of the sun at the winter solstice. The observations which have been made in Babylonia

The observations which have been made in Babylonia in the signature of the

For Figs 11-73 I am indebted to the kindness of Mr Stanley, Great Turnstile, Lincoln's Inn Fields.

NO. 1125, VOL. 44]

seeing the rising of the sun on the day of an equinox, possibly at the time which we now call Easter.

possibly at the time which we now Call Easter.
All the doors being opened, the sunlight would penetrate over the high altar, where the sacrifices were offered, into the very Holy of Holies, which we may remember was only entered by the High Priest once a year.

Have we any other evidence except the evidence and forded by temples? Yes. I thus been stated that we have no temple evidence from China, but there is a good deal of written evidence, and there is no doubt that in China the solstices and the equinoxes were perfectly well known 1100 years is C. Was it difficult to obtain this knowledge? Did it indicate that the people were great astronomer? Noting of the Guiding Order is so uses, as to determine a Noting of the Guiding Order is so uses, as to determine a

We know from the Egyptian tombs that their stock-intrade, so far as building went, was very considerable, they had squares, they had plumb-lines, they had scales, and all that sort of thing just as we have Suppose an

Il that sort of thing just as we have Suppose an Egyptian wished to determine the time of an equinox. He would first of all make a platform quite flat, he could do that by means of the square pretty sharp edges (and such rulers are found in their tombly, and in the morning of any day he would direct this ruler to the position of the sun when it is rising and he would draw a line; he would do the same thing in the evening when the sunset, he would breat the angle made by these two lines, and it would give him naturally the north and south points, and a right angle to those would give him the cast and west. So that from observant of the country of the country

the equies another way of doing it. Take a vertical rod. Suppose that the sun is rising, let the rod throw a shadow, mark the position of the shadow at sunset we again note where the shadow fails. If the sun rises exactly in the east and sets exactly in the east, those two shadows will be continuous and we shall have made an observation at the absolute equinox. But suppose of the shadows equally long before and after noon will be an east and west line.

It is true that there may be a slight error unless we are very careful about the time of the year at which we make the observations, because when the sun is exactly east or west at the time of rising or setting it is moving most rapidly. So it is better to make the above observations of the sun next the solutions than the equinose, because the countries of the sun face of the sun

Such a rod as this, which I may state is sometimes called a genome, may be used with another object in view. we may observe the length of the shadow cast by the sun when it is lowest at the winter solstice, and when it is highest; at these two positions of the sun obviously the lengths of the shadow at horn will be different. When we have the shadow into more than the shadow will be least, when the sun it more removed from the vertical the shadow will be longer.

The day on which the shortest shadow is thrown at noon will define the summer solstice; when the shadow is

longest we shall have the winter solstice.

This in fact was the method adopted by the Chinese to determine the solstices, and from it very early they found a value of the obliquity of the ecliptic.

It may be said that it is only a statement, and that the record has been falsified; some years ago anyone who was driven by facts to come to the conclusion that any very considerable antiquity was possible in these observa-tions met with very great difficulty. But the shortest and the longest shadows recorded (700 years B.C.) do not really represent the true lengths according to recent knowledge If anyone had forged these observations he would state such lengths as people would find to-day or to-morro but the lengths given were different from those which would be made to-day Laplace, who gave considerable attention to this matter, determined what the real obliquity was at that time, and proved that the record does represent an later years.

The solstices and the equinoxes were therefore in all probability thoroughly known to the Egyptians 4000 years BC, perhaps even 5000 We are then justified in considering that the temples at Abydos and at Karnak are really solar temples The Egyptians marked the solstices and the equinoxes not only by their temples but in their calendars, which these temples enabled them to construct The Chinese had also this knowledge, but we have no

information that they possessed it at so early a date.
In the next place, then, I propose to make a special study of the temples at Karnak, because they are those which are most capable of minute investigation. I do this in order to see whether any other indications can be obtained of any higher knowledge possessed by the Egyptians of

those early times.

I must again point out that we deal with the solstices in the case of the temples at Abydos and Karnak, and with the equinoxes in the case of the pyramids, some mounds in Babylonia, and the Temple at Jerusalem Since the labours of the French and Prussian Governments who have given such full records of Karnak, a memoir on the temples has been published by Mariette, which gives us not only plans, but precious information relating to the periods at which, and the kings by whom, the various parts of the temples were constructed or modified

We may begin by the general plan of Thebes find there a perfect nest of temples No doubt those which are still traceable form only a very small portion of those which once existed, but however that may be, I of those which once existed, but however that may be, i have now only to call attention to one or two among them. In the general plan we see indications that on both sides of the Nile there were temples pointing to those special amplitudes which I have before referred to What we have first to do is to refer to the solstitial temples, those which point to 26° N or S. of E or W, in which we have undoubtedly indications of the early attempts to observe, or to worship, the sun at sun-rising and at sun-setting, at the critical times—the solstitial times of the year.

The first point that I wish to make is that these temples-whatever views may be entertained with regard to their worship or the ceremonial in them-were undoubtedly constructed among other reasons for the purpose of obtaining an exact observation of the precise time of the solution. The priests having this power at their disposal, would not be likely to neglect it, for they ruled by knowledge. The temples were, then, astronomical observationes, and the first observationes

that we know of in the world

If we consider them as horizontal telescopes used for the purpose I have suggested, we at once understand the long axis, and the series of gradually narrowing diaphragms, for, the longer the beam of light used, the greater is the accuracy that can be obtained.

It is worthy of note that the direction of the temple at Karnak is quite independent of the locality, it has nothing to do with the presentation of the temple to the

although they are parallel to each other, their presentation to the river in the different localities is very various What then was the real use of these pylons and these diaphragms? It was to keep all stray light out of the carefully roofed and darkened sanctuary; but why was

the sanctuary to be kept in darkness? Independently of ceremonial reasons-there is a good deal to be said under that head-it is quite clear that the darker the sanctuary the more obvious will be the patch of light on the end wall, and the more easily can its posi-tion be located. It was important to do this on the two or three days near the solstice in order to get an idea of the exact time at which the solstice took place. We find that a narrow beam of sunlight coming through a narrow entrance some 500 yards away from the door of the Holy of Holies would, provided the temple were properly orientated to the solstice, and provided the sol-stice occurred at the absolute moment of sunrise or sunset according to which the temple was being utilized, practically flash into the sanctuary and remain there for about a couple of minutes, and then pass away. The flash would be a crescendo and diminuendo, but the whole thing would not last above two minutes or thereabouts, and might be considerably reduced by arrangements of curtains Supposing the solstice did not occur at the precise moment of sunrise or sunset, and provided the Egyptians by any means whatever were able to divide the days and the nights into more or less equal intervals of time, two or three observations of the sun-rising at the solstice on three different mornings, or of the sunset at the solstice on three different evenings, would enable a careful observer to say whether the solstice had occurred at the exact moment of sunrise or at some interval between two successive sunrises, and if the latter, what that interval was

I now come to my next point, which is that here we have the true origin of our present means of measuring time-that our year as we know it was first determined in these Egyptian temples and by the Egyptians We have seen that it did not require any great amount of astronomical knowledge to determine either the inoment of the solstice or the moment of the equinox. I think you will agree with me that the most natural thing to begin with was the observation of the solstice, for the reason that at the solstice you can watch the sun day after day getting more and more north or more and more south until it comes to a standstill. But for the observation of the equinox, of course, the sun is moving most rapidly either north or south, and therefore it would be more difficult to determine in those days the exact moment, so that I have little doubt that what they attempted in the first instance was to mark the absolute moment of the solstice. If that be so, and if Maspéro is right that Abydos was built before Menes, then we know definitely that the Egyptians could and did observe the solstices, and knew what they were doing, 7000 years ago

and knew what they were doing, 7000 years ago Before I say anything more about the use of these temples in determining the year, it is worth while to note how very different the treatment of this subject was in Egypt to what it was in Chaldesa and Babylonia and among the Jews. We do of course in. the Egyptian inscriptions read of the moon, but in Chaldea it would seem that the moon was the chief thing worshipped, and it was thus naturally the chief means used for measuring time, and, as far of course as months were concerned, this time, and, as far of course as months were concerned, the was quite right. In Chaldrea, where they were not dependent upon the rising of the Nile, and where much desert travel had to be undertaken at night, the moon and the month were the points considered, and the sun was hardly regarded at all from that point of view An in-Nile or to any other particular part of the landscape, and that point, I think, is absolutely settled by the conjoint, I think, is absolutely settled by the conjoint, I think is a basolutely settled by the conjoint, I think is a basolutely settled by the conjoint, I think is a basolutely settled by the conjoint, I think is a basolutely settled by the conjoint, I think is a basolutely settled by the conjoint, I think is a basolutely settled by the conjoint is the same category.

Thus, for instance, in Egypt the sun being used, the unit of time was a year; but in Chaldea the unit of time was a month, for the reason that the standard of time was the moon. So that when people began speaking about periods of time it was quite easy for one nation to conceive that of time it was quite easy for one nation to conceive that a period of time was a year when really it was a month, and vice versal. It has been suggested that the years of Methuselah and other perions who are stated to have lived a comiderable number of years were not solar years but lunar years—that is, propelly, lunar months. This is reasonable, since if we drived the numbers by 12 we find that they come out very much the same length as lives

are in the present day The Egyptians, taking the sun as their measurer of time, began very early with a year of 360 days. For some reason or other they divided these 360 days into months, probably with some lunar connection, so that they had 12 months of 30 days Now, we know that that is not the true length of the year, and it is clear that any is not the true length of the year, and it is creat that any nation which uses such a year as that will find its festivals going through the year. Further, such a year as that is absolutely useless for the agriculturist or the gardener, because after a time the same month, to say gardener, occasies after a time the same month, or same nothing of the same day of the month, will not mean reaping-time, will not mean sowing-time, or anything else. So that this 360-day year did not last very long; so long as it lasted, however, they knew that they got the seasons back to months of the same name in a period

of 70 years
This method led to complications, which possibly may have had something to do with the building of these temples. Egypt being exclusively the gift of the Nile, you can quite understand that their earliest calendar would be connected with the Nile, and so one finds it. would be connected with the Nile, and as one most with We and other peoples occupying the zone in the north divide the year into four seasons, the Egyptians divided it, and still divide it, into three they have four months of the flood of the Nile, then they have four months after the Nile has retired, in which they do their sowing, and summer, in which they gather their harvest.

we began, then, with a year of 366 days, and, having 360 days instead of 3654, we had a cycle of 70 years, and during that cycle each day of the year meant something different with regard to the advance of the seasons, and with regard to the work of the agriculturist and the gardener to what it had meant in the preceding year But this state of things did not last long. The 1st of the first month fell at the summer solsting on June 20, and the reason that it fell then was, that the mundation and the reason that it fell then was, that the mundation of the Nilercached Memphis on that day. Whether with the help of the temples or not, they soon got very much mearer, and changed the year of 300 for one of 306 days, which is, roughly, within a quarter of a day of the truth They had still lither 12 months of 30 days, and then they added an extra month of 5 days. With their perfectly orrentated temples they must have soon found that their correlated temples they must have soon found that their festival at the summer solstice-which festival is known all over the world to-day—did not fall precisely on the same day of the new year, because, if 365 days had exactly measured the year, that flash of bright sunlight would have fallen into the sanctuary just as it did 365 days before. But what they must have found was, that days netore. But what they must have a stall on the first day of the month, but on the day following it. They at once faced this, and found out that 365 days did not exactly make a year, but that they had to do with a quarter day in addition. What the Chinese did was this: every fourth year, instead of adding 5 days to their 360, they added 6 days, and in that way they practically brought the calendar right

Theory indicated that retaining the 365-day year, the 1st of the first month would come back to its exact relationship to the mundation of the Nile after a period

of 1460 years, the 1460 years of course depending upon the quarter being added (365 × 4 = 1460). This was known in Egypt to the priests alone. They

would not allow the year of 365 days, called the vague year, to be altered, and so strongly did they feel on this point that every king had to swear when he was crowned that he would not alter the year We can surmise why this was. It gave great power to the priests; they alone could tell on what particular day of what particular month the Nile would rise in each year, because they alone knew in what part of the cycle of 1460 years they were, and in order to get that knowledge they had simply to continue going every year into their Holy of Holies one day in the year as the priests did in Jerusalem, and watch the little patch of bright sunlight coming into the sanctuary. That stice to their year, which was supposed to begin at the solstice, and the exact date of the mundation of the Nile

solstice, and the exact date of the inundation of the Nile could be found by those who could determine observationally the solstice, but by no others. In reading books on Egypt we come across another cycle which is supposed to be a very mysterious one; in fact it is one which, I think, has not yet been sufficiently investigated, and it is very well worth the trouble of anybody who will give the time They begin with a year of twelve months, each of which has thirty days, thus giving 360 days, this was found not to work. They then tried 365 days, but that also would not work, because then tried 3c5 days, but that also would not work, because then the first day of Thoth (their first month) would only indicate the inundation of the Nile one year out of 1460; and then the priests interpolated the other day and got the cycle right, but it was not yet quite right. In the time of Hipparchus 367 3cf did not really represent the

time or ripparchus 305 25 did not really represent the true length of the solar year, instead of 357 28 we must write 305 242992—that is to say, the real length of the year was a little less than 305 days.

Now the length of the year being a little less, of course we should only get the absolute coincidence of the 1st of Thoth with the nundation of the Nile in a longer period. than the 1460 years cycle; and, as a matter of fact, the 1460 years had to be expanded into 1506 to fit the months into the years with this slightly shortened length of the year, so we have a period which is called sothic, of 1460 years, and a period which is called phanix, of 1506

There is a great wealth of interest connected with the uses of the temples from the point of view of worship, but that does not concern us here, except that it is intimately connected with the next part of the subject, for I have next to point out that it necessitated in Egypt, Chaldrea, and elsewhere contemporaneous observations of the stars I therefore now pass from the sun to the stars

I NORMAN LOCKYER.

(To be continued.)

FORESTRY IN NORTH AMERICA

N continuation of the notes under the above heading which appeared in NATURE last January, I wish to refer to a splendid paper recently read by Sir Dietrich Brandis, F R S, to the Natural History Society of Bonn It consists chiefly of a compilation from Dr Mayr's book, "Die Waldungen von Nord America" (Munich, 1890), and from works by Prof. Sargent Bernhard Fernow, the present Chief of Forestry at Washington, and some other authors, as well as from the Agricultural Reports of the United States.

Dr. Mayr is the son of a Bavarian State forest officer, and, after studying forestry and botany at Munich, he was sent, at the expense of the Bayarian Government, to observe in their native forests, at different ages, certain important ¹ "Der Wald in den Vereinigten Staaten von Nord America," von 1)r D Brandis in Bonn, 1891. (Sonder Abdruck aus den Verhandlungen der Naturhistorischen Versun, 47 Jahrg.)

North American forest trees, experimental plantings of which have from time to time been made in Germany After spending seven months on these researches, and ex-tending his tour through Japan, Java, Ceylon, and Northern Hindustan, Dr Mayr returned to Germany in 1888, and ringustan, Dr Mayr returned to Germany in 1888, and was shortly afterwards appointed Professor of Forestry and Forest Botany at the College of Agriculture and Forestry at Tokio in Japan. The present writer had the rorestry at 10kio in Japan. Ine present writer nad the great pleasure of accompanying him in January 1888 for about three weeks through some of the conferous and oak forests of the North-Western Himalayas and the subtropical forests of the lower hills near Dehra.

After leaving Germany a second time for Japan, Dr Mayr had a further opportunity of visiting North America, and thus has twice traversed the length and breadth of the country between the Dominion of Canada

and Mexico

Mayr treats of the demands of the most important North American trees as regards climate and soil, with a summary account of their anatomical structure and of the physical and technical qualities of the most important woods, and his book contains numerous illustrations. He also gives lists of destructive fungi and insects observed

by him on the different species.

Brandis has some criticisms to mete out for a few somewhat rash generalizations made by Mayr These are that evergreen broad-leaved (not comferous) forest requires a higher winter temperature than deciduous forest, and that deciduous forest vegetation is always absent in tropical countries on account of the uniformity of the climate throughout the year Brandis shows clearly, from a comparison with the deciduous forests of teak and other species in India, Burma, and Java, that this statement will not hold wherever there is a prolonged dry season, which renders the trees leafless for a certain period of the year

Another statement of Mayr's controverted by Brandis is that conifers never grow in tropical countries except where the altitude renders the chimate non-tropical, and that in North America they have longer needles, supply times in NOTIO AMERICA they have longer needles, supply heavier timber, and contain the more resin, the nearer they grow to the tropics. The latter statements may be true for Pinus australias, the putch pine of the Southern States of North America, but do not hold good in India, where the Pinus longified of the Humalayas has the where the First imperious of the symmetry many a max the tropical pine (P Merkentri), which however, has the heaviest wood of all the Indian pines, and grows in latitude 17° N, in Tenasserim, at about 600 feet above sea-level, in an absolutely tropical climate

Mayr's statement that oranges will only grow to perfec-tion in a hot dry climate is also not true for India, as tion in a hot dry climate is also not true for India, as oranges of splendid flavour are grown in enormous quantities in the damp lower hills below Cherapunj, in Assam, where the ramy season lasts for eight months, as well as in the dry regions near Delhi, and the comparatively dry country near Nagpur, in the Central Provinces

of India.

Apart from these criticisms and an interesting discussion on the origin of prairies, we find in Brandis's paper a most complete account of the distribution of North American forest trees.

Forest vegetation is much richer in North America than in Europe, containing about 412 species, distributed as follows :

Atlantic region 176 106 Pacific region . Common to both . .. 10 Central region on and surrounding Rocky Moun-Tropical species near the coasts of Florida as against 158 species in Europe.

At least six North American species of forest trees, according to Brandis, are also indigenous in Europe. being-

Cercis canadensis = Siliquastrnm Diospyros virginiana = Lotus Celtis occidentalis = austra = australis Platanus occidentalis = orientalis Ostrya virginica = carpinifolia Castanca americana = vulgaris.

All these species now grow naturally in Europe south of the Alps, and since many American forest genera existed in Europe in Tertiary times, whilst only five European forest genera (Ceratonia, Laburnum, Olea, Syringa, Laurus) are not found in America, it is possible that other species formerly common to both countries were destroyed in Europe north of the Alps by the Glacial epoch

It would take too long to describe each region in detail, and I must here merely glance at them in the

briefest manner.

A small outlier of the West Indian tropical flora extends into the south of Florida, and is followed by a broad zone of evergreen broad-leaved forest, of which Magnolia grandiflora is the chief representative We then get the pitch pinc forests on the sandy formations of Florida, Georgia, North and South Carolina, extending westwards to Alabama and Mississippi. The wood of the pitch pine (P australis) is the best conferous wood in the world, but the forests are being utterly ruined. They are tapped in the most wasteful manner for turpentine, 8,000,000 dollars being the estimated local value of the and, according to Mayr, already wide belts of white sterile shifting sands border both sides of the railways of the Gulf States, showing what the poorer tracts of the country will come to, if the farmers do not give up then pernicious habit of burning thousands of square miles of forest every year

Another tree of the Southern Atlantic zone is the swamp cypress (Taxodium distribum), growing on annually mundated land, and presumably safe from fire, if

not from ill-regulated and wasteful felling

The valuable pencil cedar (Juniferus virginiana) also flourishes at its best in the Southern Atlantic region, but grows almost everywhere in the United States and British America, from latitude 54" southwards To the north and in the prairies it has, however, only a stunted growth Hardly any sound wood of this species is now procurable, as I learned last year from Messrs Faber and Co at Nuremberg. Next to this zone comes the description of the broad-leaved deciduous forest of the temperate region, containing many oaks, walnuts, hickories, and the tulip tree (*Liriodendron tulipifera*) The heavy seeded trees are found chiefly in the south, and lighter seeded ones,

as maples, birches, and elms, more to the north
There is a long account by Brandis of the prairie region,
and the region of thinly-stocked forest bordering on it, and it appears that here, as cultivation extends, and the firedo not sweep over such vast extents of land as they did formerly, woods of Mesquit bean (Prosopis Julifiora), and other trees are spreading by seed or coppice shoots, in Western Texas, and also in Wisconsin, Illinois, Iowa, and other Street Ministers or the street was a series of the street with the street was a series of the street was series with the street was series w and other States. Much has been done in the prairie region by plantations, and these succeed admirably wherever the climate is sufficiently moist, but in the central and western parts of Kansas all planting has hitherto failed, owing to the extremely dry climate.

hitherto falled, owing to the extremely dry climate. In the northern pine zone of the Atlantic forest region, Pinus Strobkej, the Weymouth or white pine is the most important speeces, and formerly covered normous tracts from the Gulf of St. Lawrence to North Georgia, and beyond the sources of the Mississippi. At present, the only considerable supply of white pine is in Canada, and in the lake districts of the States of Michigan, Wisconsin, when the control of control of control of control of considerable control of control control of control of control of control control of control control of co

NO. 1125, VOL. 44]

and Minnesota. The timber operations in the white and Minnesota. The timoer operations in the white pine forests have only one object, which is to bring as much timber as possible out of the forest in the shortest possible time, and to make money Only the best trees are felled, and the rest burned. A forest after a timber gang has left it presents a remarkable appearance: between the standing blackened and partially charred stems of the broad-leaved and other trees which have not stems of the bload-leaved and other trees which have had been felled are the stumps of the felled pines, whilst the ground is covered with wood, which would not have paid for its removal, and rots, or is burned by the annual fires.

In 1880, there were in the three lake districts 7000 million cubic feet of standing white pine timber, whilst in the last ten years 6205 millions of cubic feet have been felled and exported, 750 millions in 1889 alone There is, therefore, little more left than can be exported in a single year. Many of the large saw-mills have already been obliged to stop work, or get timber from Canada. Chicago, which owes its rapid rise to the timber trade, imports yearly 166,000,000 cubic feet of white pine timber This is about three-fourths of the whole forest yield of Prussia, the produce of 6,750,000 acres or 10,547 square nules of forest Besides the Weymouth pine, Pruss Banksiana, the grey pine, and Pinus resinosa, and various broadleaved trees are found The sub-Arctic region of Alaska and British North America is poor in species, Puca alba and mgra, the white and black spruce, being characteristic

Merely glancing at the North Mexican forest region, with forests of Prosopis juliflora, and grassy tracts containing gigantic cacti, and Yucca baccata, a palm hly, attaining 40 feet in height, we come to the Pacific forest region, where the Douglas fir, Pseudotsuga Douglass, is the most important tree, and yields, in suitable localities, perhaps the greatest quantity of timber per acre of any

known species.

62

We finally come to the red wood forests of the Pacific coast, where Sequoia sempervirens prevails, its congener Sequoia gigantea only occurring over a limited area Unregulated fellings also prevail in the Douglas and red wood forests, and their supply cannot last much longer

Besides the wholesale destruction of forests which goes on in America, and has already driven the United States to remove all duty from Canadian wood, the most appalling destruction is now being annually caused by the floods which pour down the slopes of the mountains, bringing down boulders, stones, and gravel on the cultivated lands below Mayr has seen standing trees covered with mud up to a height of 15 feet in some of the Southern and Central States, whilst hundreds of magnificent trees lay uprooted in the full vigour of their growth. This clearly be traced to the destruction of the hill forests

How long will rulers of the United States shut their eyes to the appalling waste of the resources of their country which is still rampant! Brandis hopes that private capitalists may invest their money in forests, tempted by the rapid rise in the price of wood, and may manage them properly; but all European experience points to the necessity of State forests, and a trained State Forest Service to manage them, as the only efficacious remedy against the impoverishment of the soil and natural resources of America. W. R. FISHER.

DAILY INTERNATIONAL WEATHER CHARTS.

AT the meeting of the Meteorological Congress at Vienna in September 1873, General Myer, the Chief Signal Officer of the United States Army, submitted the following proposal:—
"That it is desirable that, with a view to their ex-

change, at least one uniform observation of such character as to be suitable for the preparation of synoptic charts be taken and recorded daily and simultaneously at as many stations as practicable throughout the world."

Although various suggestions had been made before, and synoptic charts had been previously constructed for large areas, this proposal was a bold step in advance, as the charts hitherto published—those of the English Meteorological Office excepted—were mostly synoptic only, but not strictly synchronous, whereas the plan now proposed was to treat the whole observational area of the globe as a unit, and to represent the actual conditions existing at the same instant of physical time.

The proposal was well received, and on January 1, 1875, General Myer was able to publish his daily International Bulletin, and to supplement this, on July 1, 1878, by the daily International Weather Map These publications were continued until the end of March 1884, after which time the daily Bulletin was discontinued, but the chart was issued on an enlarged scale, containing data referring to pressure and wind direction and force at all reporting stations in the northern bemisphere and over the northern portions of the Atlantic and Pacific Oceans, and this has been published up to the end of December 1887. We have before referred to the ability with which this great undertaking has been carried out by the Signal Service. The necessity of obtaining strictly simultaneous observa-tions was generally acknowledged after the discovery of Buys Ballot's law of the relation between wind force and barometric pressure, about the year 1857, and it is almost entirely due to the construction of synoptic charts over large areas that so much progress has been made in weather prediction in the last quarter of a century. This progress would hardly have been possible while each progress would nargy nave been possible while each country dealt exclusively with its own area, notwithstanding the great advance made over the old system of dealing with means of observations by the publication of telegraphic weather reports and weather charts But notwithstanding the progress already made, we are still unable to foresee what may occur for more than a day or so in advance Much more research is required, and the thousands of observations now taken on land and sea over the globe should be plotted at least once a day We should therefore much regret the discontinuance of such work as that now before us, which deals with nearly half

the globe To take one or two of the facts shown by the charts themselves: the very severe gale which visited these islands on December 8 and 9, 1886, in which about the lowest barometer reading on record was observed, will be remembered in connection with the capsizing of the Southport and St Anne's lifeboats near Formby, resulting in the loss of twenty-seven lives out of twenty-nine which constituted the two crews. In a paper upon this storm, read before the Royal Meteorological Society on April 20, 1887, by Mr. C. Harding, it is stated, after a careful examination of the materials then available, that "the Atlantic was in such a disturbed condition at this time that it is not possible to track the passage of the storm across the Atlantic with any certainty" The daily storm across the Atlantic with any certainty" International Charts, however, show the position of the storm day by day, and also that it did actually cross the Atlantic from shore to shore, and was central over the Gulf of St. Lawrence on December 3.

Another instance of remarkable weather, it will be remembered, occurred in June 1887—the Jubilee year; the weather was remarkably dry and fine in this country, there being an extraordinary drought of about thirty days. The charts for that period show that similar anticyclonic conditions also embraced a very large part of the eastern portion of the Atlantic, and extended abnormally over a portion of Europe; while the travelling disturbances are plainly shown to be confined to the American side of the

It is only Government organizations that can undertake the laborious work of producing such charts; but when they are published, the matter should not be left there: the meteorologist should make use of the materials provided for him, and endeavour to solve the problems which underlie weather changes and the general movements of the atmosphere.

IOSEPH LEIDY, M D.

THIS well-known American naturalist was born on September 9, 1823. He very early in life showed a fondness for collecting and observing insects, one of his first contributions being a paper on the mechanism which closes the membranous wings of the genus Locusta, pub-lished in 1845 in the Proceedings of the Academy of Natural Sciences of Philadelphia Having taken his degree in medicine, he devoted himself more and more to the study of natural history, and few men of any nation have left behind them a longer list of work done than this distinguished man, whose death we announced in a recent number. Leidy was gifted with great powers of observation, he possessed a correct eye and steady hand for the delineation of whatever objects he was observing, he was endowed with a faculty for work; and as he had also an excellent memory, one reflects upon his half-century of work with less of surprise than admiration To give an account of his writings would be to write a volume, to give but their titles would be to fill many of our columns, so that it must suffice to call to mind rather the subjects about which he wrote than the writings Commencing with a study of entomology, and working more at the anatomy than at the general morworking more action anatomy man at the general mo-phology of macets, he quickly passed on to the study of the entophytic worms, his "Flora and Fauna within Living Animals," published as one of the Smithsonian Contributions in 1852, having made its mark at the time Then he took up the fresh-water Polyzoa, his labours on which will be understood only when a monograph on this group as inhabiting America comes to be published Leaving for a time the study of invertebrate forms, he next entered on the field of research among the fossil vertebrates, describing in quick succession a number of remarkable fossil reptiles and fish, and he was the author of the first volume of the quarto series of reports issued by the United States Geological Survey of the Territories, under the title of "Contributions to the Extinct Vertebrate Fauna of the Western Territories" It was during his journeys to the Western Territories, that, not content with investigating the fossil vertebrates of the district, he worked very diligently at the study of the microscopic forms of life which inhabit the waters met with therein, and these researches, so far as one group of animals is concerned, were happily published by the United States Geological Survey in 1879, in one large quarto volume, "The Fresh-water Rhizopods of North America," which is illustrated by forty-eight coloured plates after Leidy's own drawings This work on its appearance was received with great enthusiasm, and is still a worthy model for a monograph During all these years, and amid so many and so varied labours, Leidy still discharged his duties as Professor of Anatomy to the University of Pennsylvania, and also of teacher of natural history to the classes of boys and girls at the Swarthmore College. No doubt many of these latter pupils will now call to mind the warm personal interest their master always took in their labours. In one of his books he tells us that since he was fourteen years of age the study of natural history was to him a constant source of happiness, but that on this joy a shadow was constantly cast when he thought how few, how very few, of those around him gave any attention to intellectual pursuits of any kind, and it saddened him to feel that the command "that man shall not live by bread alone" remained so unappreciated by the great mass of even so-called enlightened humanity. The results of Leidy's intellectual pursuits will long remain to testify to the manner of man that he was.

THE SCIENCE MUSEUM.

THE discussion on this all-important question continues I has discussion on this all-important question continues in the press. The Whitsuntide holidays have prevented any questions being asked in the House of Commons, where the feeling is very strong against the action of the Government.

As before, we reprint the most important items in the scussion. These consist of letters from Sir H. Roscoe. discussion and Profs Armstrong and Ayrton to the Times We commend to our readers the reference by the latter to Mr Goschen's treatment of the deputation, and also their judgment as to the present position of science in this country, and the teaching of it in London, as compared with Göttingen and Zurich No one can speak with greater authority than Profs Armstrong and Ayrton on this subject

Our administrative system, however, is such that the present question, which is acknowledged to be of such high importance, is being settled exclusively by officials who are quite ignorant of science. This is not said to their disparagement . it is only a statement of fact. I he letters run as follow '-

ONE cannot but feel much sympathy for Ministers, on the one hand pressed by the advocates of scientific and technical education, and on the other nervous at the prospect of not securing the gifts of the munificent but somewhat exigenst art donor the gitts of the munificent but somewhat exigend art donor. But the question is so vitally important from the point of view of seence that I feel sure no excuse is necessary if I urge most stremously that an irrevocable step he not taken without full and careful consideration, and, further, that a definite scheme for providing for the science collections and Science School be formulated before what many of us believe to be a most unwise ormulates before want many of us believe to ne's most unwise interpolation of an art gallery, on land which when bought was universally believed to have been acquired for scientific ends, as finally decided on At the present moment it is impossible to say under which thimble the scientific pea is housed, and it was no doubt due to

this that the discussion which the deputation had with the Chancellor of the Exchequer and Lord President of the Council

on Tuesday last was to some extent abortive

The Chancellor of the Exchequer, in reply to myself on
March 18, said —

"It would be possible to make adequate provision for chemical and physical laboratories on the land between the Imperial Institute Road and the Technical Institute. This site adjoins the east galleries, and it is in these galleries, together with the west and southern galleries, and a proposed cross gallery joining the cast and west galleries, that the science collections may ultimately be bound? be housed

on nouses. April 15 the impracticability of the scheme of patting part of the Science school at the south end of the eastern gallery seems to have been discovered. For on that day Mr. W. H. Sunth, in reply to Mr. Mandella, propounded another scheme for the Science School, while leaving the collections to be housed in the east and west and cross galleres.

collections to be housed in the east and west and cross gainers.

"A portion of these warnt lands" (facing the Imperial Institute)" can be unliked for the extension of the College of Institute) and the College of Institute of the College of Institute of the College of Institute of Institute

the Science College."

By the former plan a portion of the Science School would no doubt have been in immediate contact with the splendid picture gallerist in which the science objects were to be loaded; but it gallerist in which the science objects were to be loaded; but it should be supported to the science objects of the science of

When receiving the deputation on Tuesday last, a third scheme was suggested, if not distinctly counciated, by the Chancellor of the Exchequer, that the Science School extension and the Science Museum should be built on the other side of the plot Science Museum should be built on the other side of the plot given to the Art Gallery, but both on the ground recently The two smiles of the plot of t

square feet of exhibiting space, and that more than that area can be obtained on the vacant ground opposite the Imperial Institute But it must be remembered that, as stated by our Committee, this space did not provide for offices, workshops, &c —a con-siderable item; that it did not in any way provide for the extension of the Science School; and that it was made some time before an immense impetus was given to technical educa-

tion by the I echnical Instruction Acts and the grants under the Customs and Excee Act of last year curred—omatting the strip part of which has already been sold, and the remander of which is gruing to be sold for pravide dwelling house—is about one-third of the land devoted to the Natural History Museum, and almost exactly of the same area as that aiready covered by the Natural History Museum buildings, which are shortly to be

Is it unreasonable for the scientific man to urge that this vacaut land is not too much to provide for the whole range of sciences other than those accommodated in the Natural History Museum, for a proper Museum of Machinery and Inventions, for a large extension of the Science School; and possibly for the collections from the Jermyn Street Museum? Surely there can be but one answer to this question.

Why—and we have never yet obtained an answer to this

inquiry—will not the munificent donor be satisfied with another sile? Why are the existing physical laboratory and scientific class rooms to be removed, to allow an art gallery to be interested to the sile of t should look a little ahead, and not now initiate another hugger-mugger arrangement of the collections and schools at South

Kensington, which all will lament in a few years?

10 Bramhnm Gardens, S W, HENRY E ROSCOR
May 15

NOTWITHSTANDING that the recent deputation to the Pre-sident of the Council and the Chancellor of the Exchequer was headed by Sir William Thomson—the man of science whom was headed by Sir William I hom-on—the man of science whom we in this country regard as first among all others, both on account of his individual achievements and on account of his occupying the representative position of President of the Royal Society—not one single word was said by Mr. Goschen in explanation or justification of the course which he has adopted; explanation or justification of the course which he has account we therefore venture, with all respect, to assert that the Royal we therefore venture, with all respect, to assert that the Royal with one of its Fellows—for Society has just cause to complain when one of its Fellows-Mr. Goschen is one of us-thus treats representations urged by its President

Where the science collections are to be lodged, where the extensions of the Science Schools are to be placed, are in themselves all important questions; but a still graver issue remains whether a weight of opinion of the magnitude represented by the memorial recently published in your columns is to be entirely set aside because an anonymous donor has offered £80,000 plus set saide because an anonymous donor has offered £50,000 plus a collection of pictures, valued at another £55,000 That a Government which has at its head a Prime Minister whose mirrest in secence is so marked, should that unlerged the opinion offered by so representative in body of men, is one of those things which even an Englishment can sexercy understand: in OWC among the picture of the pic

We cannot help tunking that a mistake has been made in calling public attention to occutavely to the housing of the scenes collections—the extension of the Science Schools appears called of last to what is going on abrond, appearing in called of last to what is going on abrond, appearing in castellite instruction, and to the effect that is being given to scientific instruction, and to the effect that is being produced on manufacturing industries of all kinds by the high develop-ment of science and of the application of every kind of selentific

requirement. Unfortunately, in this country such matters have not yet entered into the domain of practical pointes. But in the oplasion of many among as there cannot be a question that almost superhimman efforts are necessary if this country is to regain the opation which it has given away to foregamen by it neglect to apply the highest developments of chemical and physical science to industry.

The accommodation at present afforded by the Royal College of Science laboratories is not only inadequate, but beneath con-tempt in comparison with that to be found in Continental clies, such even as Gottingen and Zurich, for example; and those of us who have some knowledge of modern requirements know full well that every inch of space on the Imperial Institute Road side of the block of land on which stands the Natural History side of the block of land on which stands the Natural Hatsory Masseam will before long be required for the purposes of the Royal College of Science. The intrusion of an art gallery into this space would have a most disastrous effect by irretirevally lead to the standard of the Science in developing intruspinous flow instruction must lead even that country to fully appreciate the value of experimental values, and to insure on proper laboratory accommendations, and to standard on proper laboratory accommendations, and to small compression of the properties of the standard of the standa

experimental studies, and to insist on proper informatory accom-modation being provided. Surely the munificent donor will accept for his gallery some other site equally good for art, and not insist on striking a blow at science by taking a piece of land already set apart for laboratories

HENRY E ARMSTRONG, Secretary of the Chemical Society.
W. E Ayrton, President of the Physical Society.

It seems probable that, as the discussion goes on, some side light will be thrown upon the motives of those who have the "munificent donor" in hand. Although we have not room for the whole of a letter from Mr Marshall of Edinburgh, the general drift of it may be stated as follows -

Mr Marshell's man point is that, according to the statements made by hir Frederick Leighton in his speech at the Royal Academy banquet, the new gallery is to be used as "a search and the statements and the statement of the stat early Italian art, is fully if not excessively represented in ou National Gallery, and while n few of our great native artists (notably Turner and Constable), and many of our small ones, are represented far beyond what is necessary or even desirable our native water-colour art is practically not recognized at all, and many of the very greatest of our masters in our, who were (most of) them most recommend to the colour masters in our water of the colour masters of the colour master of t our native water-colour art is practically not recognized at all, now endeavouring to steal the stones that others nave quarrous and hewn for the martys' moment in order to erect with them another comfortable massion for themselves." Mr. Marshall is of opinion that "provincials" have opportunities more than enough of seeing contemporary art. Their wish now is to have a chance of studying fine specimens, authoritatively selected, of the acknowledged masters of our English school. The possible existence of such special motives as those here suggested among the persons who are attempting to get a grant of land for the carrying out of their so-called national objects should form an additional inducement to men of science to redouble their efforts.

NOTES.

This general programme for the Cardiff meeting of the Binsh Association has now been arranged The first meeting will be held on Welnesday, August 19, at 8 p m., when Sir Frederick Alek, K.C.B., will resign the chair, and Dr. Williams Hüggins, President-elect, will assume the presidency and deliver an address. On Thranday evening, August 20, at 8 p m., there will be a sorte, on Friday evening, August 21, at 8 30 p m. will be a sorted. On Friday evening, August 21, at 8 30 p m. and absocurs on You From Lin Chair in the Life of Aquatic Insects, "by Frof L. C. Minll, on Monday evening, August 24, at 8 30, p m. a sorted. On Wednesday, August 26, the concluding general norming will be beld at 3.0 p m. and the sorted of the August 25, the concluding general norming will be beld at 3.0 p m.

THE arrangements for the International Congress of Hypiene and Demography are nearly complete, and the programme, corrected up to May I, has been assued in the form of a pamph-It has been definitely fixed that the opening meeting, at which the Prince of Wales is to preside, shall be held on Monday, August 10, at 3.30 The sections (of which there are ten) will meet on the four following days from 10 to 2 The six medical and scientific sections will meet in the rooms of the Royal and other learned Societies at Burlington House The University of London will give the use of its large theatre to the section for the hygiene of infancy and childhood, and two examination halls to the sections for architecture and engineering The division of demography will meet in the Theatre of the School of Mines, Jermyn Street Much attention is being given to the necessary social preparations, and there is already a long list of proposed entertainments and excursions

A CEMERAL meeting of the Federated Institution of Mining Engineers will be held in London on Thursday, the 28th inst, at 12 noon, and on Fridsy, the 29th, at 10 a m, in the rooms of the Institution of Civil Engineers, 25 Great George Street, Westimister Various works will be visited on the 29th inst.

THE Committee of the Cardiff Naturalists' Society have put on foot a petition in favour of Mr. Pease's "Bill to Amend the Wild Birds' Protection Act, 1880." They are appealing to other scientific societies to join with them in order to make the petition as effective as possible

AT Mowbray, a suburb of Cape Town, Mr Cecil Rhodes has bought for £16,000 land on which, it is understood, the proposed University is to be built

This death of Prof. Carl Withelm von Nageli, the emment botamist, is announced. He died at Munich, on the 10th inst, in in the 74th year of his age, and will be buried at Zurich, in accordance with a with expressed before his death. Prof. von Nageli was a Foreign Member of the Royal Society We hope on a future occasion to give some account of his scientific labours

This Australian papers announce the death of Dr. Richard Schomburgh, brother of the lates its Robert Schomburgh, and for many yearn Director of the Botanic Gardens at Adelands, South Australia Dr. Schomburgh was associated with his brother an the Boundary Denarcation Commission of British Gunsan in 1849, and, some yearn later, settled with another brother in South Australia as a farmer and wine-grower On the death of Mr. Finnels, in 1866, he was offered, and accepted, the post of Director of the Adelande Botanic Gardens, which be held with much distinction until his death. He was an

enthusiastic horticulturist, rather than a hotanist-that is to say. as an author; and his services in connection with the establishment he directed were very highly appreciated, as the sketches of his career testify. Indeed, so long ago as 1883, a large number of his admirers subscribed the funds to procure his portrait for the Museum of Economic Botany, founded by himself His literary work commenced, we believe, with his "Reisen in Britisch Guiana in den Jahren 1840-1844," the third volume of which is devoted to a "Versuch einer Flora und Fauna von Britisch Guiana," in which Schomburgk had the assistance of several other botanists. This work has not yet been superseded, though its usefulness is unfortunately much limited by the publication of a large number of new names without descriptions. In 1876. Dr. Schomburgk supplemented this work by his "Botanical Reminiscences of British Guiana" But his most valuable literary work relates to the botany, to the agricultural and horticultural capabilities of his adopted country, and expecially to the Botanic Garden, of which he was to a great extent the creator. His name will long be remembered in connection with this establishment, which is, it is asserted, the "most complete paradise of flowers in the southern hemisphere."

ACCORDING to the Calcuta correspondent of the Timet, the Miranza Expedition, under Sir W Lockhart, has obtained much valuable geographical information about places which, although within a few miles of the fronter, have been follered unwisted by Europeans. The surveys effected by the Kuram field force during the Afghan war have been carried on to the Karanana Valley.

A Russian scientific expedition, under the command of Captain Bartshevsky, has left Samarcand for the exploration of Southern Bokhara, the Pamir district, and Kafiristan

On Saturday, May 30, at the Royal Institution, Prof A H. Church, Professor of Chemistry in the Royal Academy of Arts, will begin a course of three lectures on the scientific study of decorative colour

THE Rev H N, Hutchinson has undertaken to write for Messr. Swan Sonnenschein and Co 's "Introductory Science Text-books" a manual of physical geology A second edition of Dr Hatch's "Petrology" in the same series, reviewed in our columns latt week, has already appeared.

MESSAS WINITAKE'S CO have in preparation a "Labrary of Popular Science" Among the works to be included in it are "Astronomy," by G F Chambers, "Light," by Sr H Trueman Wood; "Chemistry," by T Bolas, "Mineralogy," by Dr F. II. Hatch, "Electricity and Magnetism," by S. Bottone; "Geology," by A J Jukes-Brawn; "Botany," by G Massee

MR J ALLEN BROWN has expounded in the West Muldlesex Standard an excellent scheme-now printed separately-for a technical institute and museum for the Ealing Parliamentary division of Middlesex. This division comprises Ealing, Acton, and Chiswick, and Mr. Brown's proposal is that a technical institute and museum should be established in whatever position may be most convenient for these localities. An essential part of his plan is that the instruction shall be imparted by specially qualified teachers and lecturers, and that their duties shall be "migratory or peripatetic," so that classes may be conducted or lectures given in any part of the division, and on any of the subjects contemplated under the Technical Instruction Acts. We commend Mr. Brown's scheme to the careful attention of the Middlesex County Council, which will soon have to decide as to the distribution of the funds placed at its disposal for technscal instruction. There can be no doubt that the proposed institutions would be of immense advantage to the three districts, for Mr. Brown has a very enlightened conception of the true nature of technical instruction. What he wishes is that the young workman shall acquire "a knowledge of the scientific or artistic principles which are applicable to his trade or industry," and that by the development of his powers of observation and insight into the laws which govern all things "he may afterwards be eaabled to effect improvements and excel to a greater extent thus heretofour; in the work he desires to accomplish."

66

THE GUILDIGEN Society of Sciences has recently offered the following prise in physus for Scienceber 29, 1893.—From the researches of W kongen and A Kundt on variation of the optical properties of quarts in the electric field, there appears to be a close connection between the electro-topic phenomena and the elastic doffunctions which that piece determ is butance shows under the action of electrostatic forces. An extension of these inquiries to a series of piece decirie cryatals with various properties of symmetry seems highly desirable. The unweigitation should also be directed to distriming whether the electro-opinc phenomena in pixzo-electric crystals are easiest exclusively by the desformations courring in the electron field or, beaudes, by a direct action of the electrostatic forces on the lighth-motion. Priv. £35

THE German Society for the Encouragement of Industry offers the following (among other) prizes. (1) How far is the chemical composition of steel, and especially the amount of carbon present, a measure of the usefulness of cutting tools? Prize, a silver medal and £300, date, November t5, t89t (2) A silver medal and £150 for the best chemical and physical investigation of the most common iron paints Date, November t5, t894 (3) A gold medal and £150 for the best work on the magnettsm of iron This should comprise a critical comparison of previous observations, also personal observations on steel and wrought iron bars of the most various chemical composition possible, examination being made both of the strength of temporary magnetization with absolutely measured and varying magnetizing force, and the strength of permanent magnetism and its durability with regard to temperature-changes and vibrations. Date. November 15, 1893. (4) Investigation of the trustworthiness of the usual methods of determining the carbon in iron Prize, a silver medal and £150; date, November 15, 1892).

THE extraordinary collection of mummies, papyri, and other objects of antiquarian interest recovered last February at Deir-el-Bahari is now safely housed in the Ghizeh Museum According to the Calro correspondent of the Times, all the objects are in good condition, although some anxiety was caused by the protracted journey by boats from Luxor The correspondent says that the mummies mostly belong to the 21st Dynasty, and, though styled Priests of Ammon, are supposed to be the corpses of generals and other official dignitanes who bore ecclesiastical besides other titles. The 163 mummies and the 75 papyri are not yet unrolled, and it is difficult to form an estimate of their archeological value, as many of the sareophage bear different names on the outer and inner casings. whilst others have the names usually inscribed on the outer casings intentionally effaced. M. Grébaut thinks that, owing to this circumstance and the magnitude of the collection, some time will be required before any important communications can be made to the scientific world.

A SERIES of experiments has been lately made by Herr Robert (Archive juri Hyperace), with regard to the familiar fact that not only dry high temperatures are more easily borne than moist, but dry cold causes much less discomfort that moist cold. Dogs, fasting or fed, being observed in an all-calorimeter, it appeared that, in all cases, most air increased the loss of the best by conduction and radiation. For every variation of the air-moisture t per cent, beat was parted with to the extent of 033 per cent. In a persons ineveigation, Herr Robert

demonstrated the lessened yield of water by evaporation from anumals where the ar-monature is increased, involving leasened loss of heat. Here, then, are two antagonistic influences. He subspoted to regard the increased radiation and conduction in most as as the primary action, and the disminished evaporation as secondary. The colder feeling of most to dit has day is readily explained by the increased heat radiation. In most hat, with the sense of oppression it brings, this factor passes rather into the background. The degree of temperature, and offect the amount the contraction of the complex nature, also affect the amount the manufactors.

THE Meteorological Council have issued a publication containing the hourly means obtained from the self-recording instruments at their observatories for the year t887. This work constitutes a new departure in the use made of the records of the self-registering instruments, and one which we think will be of much practical use to meteorologists. The publication of the hourly observations in extenso, at the request of a number of scientific men, began with the year 1874, and was continued until t880, in a lithographed form, and the daily means were added in t879, from the year t88t to t886 they were issued in a printed form The Council, after careful consideration, have now come to the conclusion that it is preferable, for a time at least, to publish mean values only; hitherto no hourly means had been published by the Office, but in the present work these have been grouped into five-day and other periods, in a convenient form for discussion, and the necessity for dealing with an excessive number of values has thereby been obviated, while many useful tables not included in the old series have been added. It is proposed to calculate the means similarly for earlier years, while the original records will be carefully preserved, and will be available, should they be needed, for any special research.

THE Annual Report of the Director of the Royal Alfred Observatory, Mauritius, for the year 1889 shows that the island has again enjoyed immunity from storms; the greatest hourly velocity of the wind was 31 miles. The almost total absence of tropical cyclones in the South Indian Ocean during the year is considered by Dr. Meldrum as another confirmation of the law that these cyclones are fewest in number and least intense in the years of least solar activity. The mean temperature was 0° 7 below the average for the last fifteen years, and below the average in every month except July and October The maximum shade temperature was 93° I on March 27, and the minimum 52° 4 on June 18 The rainfall was 8 56 inches above the average, the greatest fall in one day was 3 88 inches on March 11, although this amount was much exceeded in other parts of the island On January 1, a waterspout burst on the Pouce Mountain, Port Louis was flooded, and some persons were drowned. The collection of observations made at sea is actively carried on; 324 log-books were received, and the observations duly tabulated The Report also contains observations made at the Seychelles and Rodriguez.

In a paper receasily published in the Metamologische Zutschrift, Prof. Hellmann, of Bertin, shows, from observations taken at different British, Continental, and American stations at which barggraphs are used, that there actus a close conscidence in the daily range of the monthly extremes and in that of occurrence of the highest and the lowest readings of the barmeter during a month agree almost completely with the hours of occurrence of the highest and the lowest readings of the barmeter during a month agree almost completely with the times in which the normal daily range has its maxima and minima, both curves being so multiar in abape that it may be possible to judge of the general character of the daily range of the barometer from knowing only the hours at which the monthly extremes mostly occur. Hence, as the lowest readings of the barometer are accompanied by cloudy and stormy weather, during which the effect of the solar radiation upon the surface of the earth and the heating of the lower strans of the strong-fere are quite insignificant. Prof. Hellmann concludes that Prof. Hann and others are light in assuming that the normal duly range of the barometer is chiefly an effect of the absorption of the solar ray; in the upper stans of our atmosphere. Prof. Hann has applied the harmonic analysis to the numbers furnished by Prof. Hellmann, and, by combining several stations in a group, has found the coefficients of the periodic formula to be practically the same as those for the normal duly range. We should, however, like to see a further confirmation with respect to the continuation of the continuation of the confirmation with respect to the continuation of the confirmation with respect to the continuation of the confirmation with the confirmation with the confirmation with the confirmation with the other and the confirmation with the confirmation with the other and the confirmation with the confirmation with the other and the confirmation with the confirmation with

THE first paper in the last volume of Transactions of the Seismological Society of Tapan is by Mr. Bertin, and describes the double oscillograph and its employment for the study of rolling and pitching. It traces curves automatically, showing the motion produced in a floating body by waves The second paper is on the "Seiches" of lakes, by Dr F A Forel, of Geneva, and discusses those variations in the level of the water of lakes with the investigation of which the author's name has been associated for some years past. Prof. John Milne de scribes the remarkable instrument invented by him for measuring and recording the oscillatory movements of railway trains. Mr Mason contributes a paper, accompanied by carefully compiled tables, demonstrating the importance of elaborating some uniform system of timekeeping for the purposes of seismological observations Prof. C. G Knott, in his paper on earthquake frequency. explodes two of the time-honoured delusions of the popular mind in regard to earthquakes, viz that they are more frequent during the night than the day, and that their periodicity is connected with lunar culminations. Mr Otsaka gives an interesting account of the great earthquake that visited Kumamoto in July 1888, and Mr Pereira contributes a carefully compiled record of all the earthquakes noted by him in Yokohama from March 1885 to December 1889 Mr W. E. Forster writes on earthquakes of non volcanic origin, caused, it is suggested, by the displacement of masses of land beneath the occan The volume concludes with various reports and papers by Prof Milne, such as diagrams of earthquakes recorded in Tokio, a report on earthquake observations made in Japan during the year 1889, and an essay on the connection between earthquakes and electric and magnetic phenomena, which is full of matter of an interesting and suggestive kind.

ACCORDING to the Colonies and India, Mr. Alexander McPhee, a West Australian bushman, who has steadily been earning fame lately by his explorations in the central regions of Australm, started inland from Roebourne in July last on another tour of discovery, taking back at the same time an albino aboriginal whom he found and brought to Melbourne a couple of years since. News has been received from which it appears that Mr. McPhee, with the albino, Jun Gun, and a "black fellow" named Timothy, went along the coast some 250 miles to a station called Yinadong, when the party turned mland in an easterly direction After travelling about 350 miles, Mr. McPhee came upon another albino, a boy of fourteen years, whom he describes as the most extraordinary specimen of humanity he ever saw. One old man in this camp told Mr. McPhee that when he was a boy he heard of a party of whites and horses dying a long way inland. The old fellow could give no particulars about this party, but Mr. McPhee feels certain, owing to his acquaintance with the habits and customs of the blacks, and being thoroughly conversant with their dialect, that a party of white men perished about forty years ago somewhere in the

interior. He heard of Warbarton's party, and saw a native who told him that he guided them to vaier. He also heard of two parties of whites who had lately been in the desert, but turned hack From his turning point to the coast of La Grange Bay, Mr McPhee rectons he was about 250 miles in a south-cast officient of the coast of La Grange Bay, and on no occasion was it necessary to keep a watch. The country is described as very poor. The only blied solserved during the pourney were an old crow and a few sparrows about the water; not a track of a hangagoor ore min was seen.

SOME satisfactory statements as to the growth of collegiate education are made in the last official report on public instruction in the North-West Provinces and Outh Of individual colleges. Agra, at which the numbers in 1885 had fallen as low as 45, has increased within the last two years from 07 to 175, or by over 80 per cent, and the percentage of increase last year was in no case less than 20. The number of matriculated students. indeed, is rising so rapidly that the existing accommodation is said to be barely adequate, it will, the Government resolution says, become a question of urgent importance whether the in creasing number of students should be provided for by additions to the staff and buildings at the colleges now in existence, or by the creation of new colleges, or by the strengthening of the college classes at high schools and adding to their number. "Government," it is added, "will necessarily be guided to a great extent by the nature and direction of the local demand, as indicated by the willingness of the residents of the principal towns to contribute to the increased burden of expenditure " On its present basis, at all events, the higher education of India has received a fair share of Government support. But if it is satisfactory, says the Pioneer, to find that collegiate education in its present form is making decided progress, and that it is becoming possible to throw the cost of the advance on private shoulders, it is a distinct disappointment that not a word is said, as not a step has been taken, in those new directions of educational activity where other provinces have not only started, but made appreciable progress There may be two opinions as to the extent to which, or the means by which, it is possible to introduce technical education, but there can be no question that some movement is desirable. It may be hoped that the omission is due, not so much to a failure to estimate the importance of the subject, as to a desire to give it fuller treatment on a future occasion

Tits amount of apparent flatening of the vault of the heavest Prof. Remain has lately attempted to measure by noting the point which seems to baset an are extending from the senth to the horson. From \$3 observations at Hirscheept, the found that this point was at "47 # 2 0.08 above the horson. This indicates a ratio of the vertical axis to the horsonal of 1 ; 3 66. This apparent flattening has an annual period, and is dependent on eloud. The highest position of the baseting point was assigned in autumn (21° 98), the lowest in spring (20° 42). The vault become flatter the more the cloud. It teems least flat with a misry horson; and the flattening seems less by might than by day. Curously, seemed other persons whom Prof. Remann got to make the same determination all gave higher values for the angle

This settlement of a purely philological question (that, namely, as to the position of the French scenal), by a physical method, has been recently attempted by Dr. Pringhteim, off Bertin (Maturus, Radio 3). The instrument used was Noing and Scott's phonautograph, into which a number of Frenchmen were required to speak; the measurement of the record being afterwards to speak the measurement of the record being afterwards. This instrument renders possible at determination of the duration, pitch, and intensity of each vigible, and Dr. Pringsheim.

discusses its indications As a preliminary result, he finds that two-syllable words have the vowels pronounced with equal length and strength. Noteworthy differences appear in the curve of a word according as it occurs in the middle or at the end of a sentence. In the latter case, there is added to the characteristic word curve, a terminal curve with declining pitch and strength, which is nearly the same for different words, and corresponds to the sinking of the voice before a pause vowels and consonants show characteristic curves, and notably long wave-lengths occur with w. L. b. and d The duration of syllables varies between 0'1 and 0 5 second; and between the syllables of a word there are often pauses of 0 03 to 0'2 second The shortest syllable I in He, with rather slow pronunciation, consisted of 22 vibrations, yet the ear is capable of not only hearing the tone, but of detecting fine shades and differences in the mode of pronunciation. Further experiments in this direction, with an improved apparatus, are contem-

THE Perak Government Gazette states that a portion of an ethnographical collection formed by Signor G. B. Cerruti, In the island of Nias, has been recently acquired by the Government of Perak for the museum Pulo Nias is one of a chain of islands bordering the south-western coast of Sumatra. The population is said to be numerous and of one race, though divided into many tribes under independent chiefs. Headhunting is as common with them as it used to be in Borneo, and most of the houses have skulls hung up in them Their weapons consist of iron-headed spears, mostly barbed, knives of two patterns, somewhat resembling the Kadubong Achi, with shields of two distinct types No boxs and arrows or blow-pipes seem to be known, nor are throwing sticks applied to their spears, boats also are not used by them, though rafts are sometimes made to cross the rivers on. The ironwork of their weapons is fashioned by themselves, and the upright double cylinder bellows is used to supply wind to their forges-the same in every respect as those used by the Semangs of Upper Perak, and the far away Malagasy Helmets of black 130h fibre are worn, somewhat similar to the cocos-nut fibre ones of the Sandwich Islanders. Woven body armour is in use, in the shape of thick coats made of what appears to be the fibre of Hibiscus teleacens Buffalo hide armour is also said to be used, but is not represented in this collection Attached to the sheaths of some of the knives are four or five animals' teeth, such as tigers, rhinoceros, &c , also a small carved wooden idol, and one or more bamboo boxes containing stones In those examined there were twelve publics in each hox. These stones are supposed to have been taken from the spot on which a man had been slam charms are tied up into a bundle with red cloth, and bound with string on the upper front part of the sheath of the knife.

A COMPREHENSIVE study of the influence of forests on the daily variation of air-temperature has been recently made by Prof Muttrich (Met. Zests.), the data being from stations in Germany and Austria. Inter alsa, this influence is greater in May to September or October than in the other months In pine and fir woods it rises gradually from January to a maximum in August or September, then falls more quickly to a minimum in December, but in beech woods a minimum occurs in April, then there is quick rise, till the maximum is reached in July. The daily variation itself is greatest in May or June, both in forest and open country. The influence of the forest is to lower the maxima and raise the minima, and the former influence is in most months greater than the latter; in December and January. and occasionally in neighbouring months, it is less. The influence on the maxima in summer is greatest in beech woods, less in pine, and least in fir. The absolute value of the influence an woods of a given kind of tree is affected by the degree of density

of the wood, being higher the denner the wood. The character of the chunse (coann or continental) also affects the results From daily observations in forest and open country, every two hours in the second half of June, it appears talk, soon after 5 am and 8 p m , the air-temperature in the wood was equal to that in the open p that the maximum was about of 9 lower in the wood, and the minimum or 6 higher; that in May to September the difference sometimes resched $2^{**}7$; that the maximum in the wood occurred about half an hour later, and the minimum aquarter of an hour earlier, than in the open; and that the daily mean air-temperature was about $\frac{1}{2}^{**}$ less in the wood

THE Revue des Sciences Naturelles de l'Ouest gives an account of the life of Mathurin Rougult, one of the pioneers in the geology of Britishy. Rousult was born in 1813, of a very poor family At the age of ten, while engaged as a shepherd, he became interested in "stones" and "rocks," and began to make a collection. By the death of a relative he obtained possession of a small hairdresser's shop, where he worked on Saturdays and Sundays, spending the rest of his time in hunt ing for rocks. Although Geoffroy Saint Hilaire visited his collection of specimens, and was much interested in them, nothing would have been done for the poor young geologist-who lived upon something like five centimes a day-if it had not been for General de Tournemine, who, stationed with the garrison in Rennes, had been attracted by him It is said that one day he went into the shop, and, seeing an antique pistol which Rouault had bought for a few centimes to kill himself with, the general remarked, "That is just the pistol I am after I want it for my collection " And without waiting for an answer he took the pi-tol, and gave the young man 100 francs M de Tournemine went still further He revised a memoir which the illiterate geologist had written. This was read in the Academy of Sciences, and met with so much success that the author became well known. The town of Rennes gave him 800 francs a year to help him to live in Paris, and afterwards he was appointed Director of the Geological Museum of Rennes But he was dismissed on account of quarrels with some unintelli gent bureaucrat, and died in 1881. Before his time only five or six fossils were known in Britiany afterwards they numbered 500 or 600 He spent two years or more in making up Trinucleus Pongerards out of over 2000 fragments

An important paper upon the atomic weight and position in the periodic system of the rare element lanthanum is contnbuted by Dr Brauner, of Prague, late of the Owens College, Manchester, to the current number of the Berachte In his recent work upon the reduction of oxides by metallic magnesium Prof Winkler advanced the view that lanthanum is a tetravalent element of atomic weight 180, instead of, as has hitherto been accepted, a trivalent element belonging to the boron vertical group of the periodic system, with an atomic weight of 138 5 If lanthanum were indeed tetravalent with atomic weight 180, it would probably be the missing element between ytterbium and tantalum on the one hand, and cerium and thorium on the other Further, Prof. Winkler expresses the opinion that the old values of Rammelsberg, Zschiesche, and Erk, for the equivalent of lanthanum, are correct. These experimenters obtained the round number 45 for the equivalent, and this number multiplied by 4 gives Prof. Winkler's suggested atomic weight 180 If, however, multiplied by 3, the atomic weight 135 is arrived at, and Prof. Winkler argues that even if the element were trivalent its atomic weight would not be 138'5 but 135. Against these views Dr. Brauner brings forward the following experimental facts. In the first place, Hillebrand (working under Bunsen) found the specific heat of Bunsen's pure lanthanum to be 0'04475. No impeachment has ever been brought against this result, and Dr Branner

sees no reason why it should not be accepted. Making use of Dulong and Petit's generalization and multiplying this number by 138, a normal atomic heat of 6'18 is arrived at, whereas if multiplied by 180 the abnormal value 8 07 is obtained Again, an element of atomic weight 180 should possess a density of 8 2, whereas that of lanthanum is only 6.48, a specific gravity corresponding to an atomic weight of 138. Considering therefore the position of lanthanum in the trivalent boron vertical group assured, Dr. Brauner brings forward a redetermination of its atomic weight of his own in order to decide between 138's and 135 His experimental method consisted in converting known weights of the oxide into sulphate. The material employed was obtained by a lengthy process of fractionation with ammonium nitrate, the oxide eventually obtained containing the most positive of the certte earths (lanthanum oxide) and showing no traces in the spectrum of any others His value thus obtained is 138 2, a number closely agreeing with those of Cleve and Bettendorff The earlier and lower values of Rammelsberg and others are shown to be probably due to the presence of yttria, which was not detected by these observers, masmuch as the work of Thalen and Bunsen upon the spectrum of yttrium had not then been published. Hence lanthanum of atomic weight 138 2 retains the place in the trivalent group of the periodic system marked out for it by its well-known basic properties.

THE additions to the Zoological Society's Gardens during the past week include a Striped Hyana (Hyana striata ?) from India, presented by Mr. B T Ffinch, C.M.Z.S., two Hairyrumped Agoutis (Dasyprocta prymnolopha) from British Guiana, presented by Mr. H Barrington; two Brent Geese (Bernicla brenta), a Pintail (Dafila acuta 8), two Wigeons (Marcea penelope & 9), a Common Sheldrake (Tadorna vulpanser 9), two Golden Tench (T)nea vulgarss, var), nine Golden Carp (Carassius auratus), British, presented by Mrs. Atkinson , eight European Tree Frogs (Hyla arborea) from the South of France. presented by Mr Clifford D. Fothergill; a Crested Porcupine (Hystrix cristata) from India, a Tibetan Crossoptilon (Crossoptilon tibetanum 9) from Western China, deposited , two Swin hoe's Pheasants (Euplocamus swanhous & 9) from Formosa, two Japanese Pheasants (Fhasianus versicolor 9 9) from Japan, two Amhern's Pheasants (Thaumalea amherstur 9 9) from Szechuen, China, a Black-necked Stilt Plover (Himantopus nigricollis), a Cayenne Lapwing (Vanellus cayennensis) from South America. purchased, a Wild Swine (Sur scrofa 9) from Persia, received in exchange, two Indian Desert Foxes (Cams leucopus), born in the Gardens.

OUR ASTRONOMICAL COLUMN

THE PHOTOGRAPHY OF FAINT NEBULA -In the Journal of the British Astronomical Association for February, Dr. Max of the British Astronomical Association for Section 1988.

Well, of Heddeldery Claseratory, continues a note on a note on a note on a note of the section of

NO. 1125, VOL. 44]

the like-bodies having a finite area. The intensity of the image at the focus then varies as the fraction $\binom{d}{r}$, where d is the diameter of the object-glass, and f its focal length. If, therefore, the intensity of the light received with an aperture of zo inches and focal length of 100 inches be expressed by 0044, that of a portrait lens of 4 inches aperture and 12 inches focus so 11. This shows that in order to photograph the same faint nebula, the instrument of 20 inches aperture requires an exposure about three times at long as the 4-inch portrait lens.

Another paper having the same purport is contributed by Dr Holden to vol in No 14, of the Publications of the Astronomical Society of the Pacific, from which it appears that from 80 to 100 minutes' exposure with the 33 inch Lick telescope will give minutes' exposure with the 33 inch Lick reiescope will give about the same number of vlars as 205 minutes' exposure with Mr Roberts's 20-inch reflector. When, however, the amount of nebulosity depicted is considered, the advantage is considerably in favour of the short-focus reflector, a comparison of the results. obtained with the two instruments indicating that 15 minutes' exposure with the reflector is about as effective in showing the nebulosity of Orion as 60 minutes' with the refractor

VARIATIONS IN LATITUDE -Prof 11, G, van de Sande WARIATIONS IN LATITUDE—Prof 11, G, van de Sande Bakhuyren extends our knowledge of this subject in a paper contained in the March number of the Monthly Notices of the Royal Astronomical Society The conclusions deduced from th e investigation of observations of Polaris made befrom the investigation of observations of Polaris made between 1851 and 1852, and the interesting researches of Mr. Thackeray (Memoirs R A S, vol xlix p 239), may be summed up as follows—(1) The monthly discordances in the zenith distances of Polaris are, for the greater part, not caused by a real variation of faittude, but theigh by an effect of temperature (2) It is not possible to explain those discordances by an error in the indication, of the exterior thermal part of the exterior thermal part of the properties of the exterior thermal part of the exterior t mometer, or by an influence depending only on the exterior temperature (3) The discordances can be explained, for the greater part, by a cause depending on the difference of the greater part, oy a cause depending on the difference of the exterior and interior temperatures (4) Probably that cause is a refraction in the observing-room, and its effects are sensibly proportional to those differences of temperature. (5) The discordances corrected for that refraction are about the same for both culminations, and can be explained by a real variation of

An investigation of the mean North Polar distances of Polaris in both culminations observed at Greenwich between 1883 and 1889 leads to the conclusions (1) that it is probable that the observations of Polars at Greenwich confirm the variations of observations or learn at Greenwich country the warrations of lastitude observed elsewhere in 1884-1885 and 1889-1890; (2) that there is a very strong probability that the variations in these years had an exceptional character, and do not agree with the annual variations, deduced from the observations of Polaris at Greenwich during the period 1851-1882.

RE-DISCOVERY OF WOLF'S COMET (1884 III) .- Astro-RE-DISCOVERY OF WOLF'S COMET (1884 111).—Astro-monache Machachiem, No 3033, contains the information that Wolf's periodical contect was observed on its return by Prof Barnard, of Lick Observatory, on May 37932 (M.T. The following ephemens is from one given in Edinburgh Circular No. 15, by Prof. Berbench. The brightness of the comet at re-discovery has been taken as unity.

Ephemeris for Berlin Midnight

1891.	Right Ascension.	Dechnation	Brightness
36	h m s	1	
May 23	23 16 31	+ 17 47 1	I 44
,, 27	25 42	18 42.8	1'54
_*, 31	35 o	19 37 7	1.65
June 4	44 26	20-31 4	1 77
,, 8	53 59	21 23 9	1'90
,, 12	0 3 40	22 14 9	2 03 2 18
,, 16	13 30	23 40	
,, 20	23 26	23 50 8	2,33
,, 24	33 32	24 35 2	2 50
,, 28	43 45	25 16 9	2168
July 2	54 5	25 55'4 26 30 3	2.88
,, 6	1 4 34	26 30 3	3 08

The comet will pass perihelion on September 3'3199 Berlin mean time. It is near a Pegasi at the present time, and may therefore be seen just before sunrise. The motion is towards

THE PARIS ORSERVATORY

THIS report opens with the address delivered by the Director,
Admiral Mouchez, before the Council of the Observatory
on February 24 last, the following is a brief summary of the

on February 24 last, the following as brief summary of the most important pounts touched upon more than the most important pounts touched upon problem of the building for the large equatorial could, in which the instrument is now being execute, and to the formation of a special service for spectroscopy, over which M. Dealandres has been put in charge mention of the problem of th the objects that physical astronomy studies in order to penetrate more and more deeply into the knowledge of the universe, admit more and more deeply into the knowledge of the universe, anni-indeed of new processes of observation of such delicacy that they are allogeber incompatible with the turmoil and dis-turbances of all kinds in a populous city. The instruments with large optical power lose nearly all their superiority, because they magnify the defects of an impure and disturbed almosphere at least as rapidly as the images of the stars

rease as repress as the images of the stars.

This is by no means the first time that this question of a branch establishment has been raised, but it looks very much as if it might now be taken up seriously. It seems that a proposal has been made to extend the railroad from Secux-Limours in the interior of Paris to Médicies and Cliunv. where it Limours in the interior of Paris to Médicis and Cluny, where it would join the metropolitan; if this project was carried out, trains would run as close to the Observatory as 150 metres, thus affording the assistants at the Observatory an interesting amusement in calculating the distances of these trains by the vibrations set up in the various instituments

A committee of inquiry, presided over by M Chauchat, has been formed to inquire into the situation, and the unanimous

opinion of all the astronomers questioned on the subject was that "the Observatory would be almost lost if this project was carried out according to the present conditions"

carried out according to the pretent conditions."

Of the other arguments put forward by Admiral Mouchez in favour of the branch establishment, the following may be mentioned. The lighting of the surrounding streets by means of the electric light. This, as he says, would obliterate all says. of the electric light. This, as he says, would obliterate all stars above the 11st Inagnitude, and perhaps even above the 11st In, to say nothing of the minor planets, nebulæ, and some comets. And with regard to photographing the heavens with moderate exposures, it would become nearly impossible owing to the fogging of the plates before the images are formed, the gas from fogging of the plates before the images are formed, the gas from the attreat lamps even now producing the effect on the sensitive plates. Referring to the opening and enlarging of the Rue Cassnip, he points out, that at no remore date, houses will be constructed from 20 meters to 25 metres to height at a distance of 100 metres, and just in the direction of the mendian line of the instruments, these, besides completely blotting out from view many of the arcumpolar stars at their lower culimation, will render the observation of those that remain difficult on

will render the observation of those that remain difficult on account of the smoke from the chimneys.
Following Admiral Mouchez's address are the reports, from each of the heads of the various departments, of the work done during the past year
With the mendiani circle no less than 14,374 satisn have been observed, actisuise of the 432 observations of the planets made with the same instrument. Observations of the planets made with the same instrument. servations which were commenced in the month of April with the equational could, bave been regularly pursued, and at present the results have been highly satisfactory. Not only "do we believe that we have settled in every detail the most precise rules for the application of the new method, but also we have obtained the constant of aberration with an exactness which surpasses all researches made up to the present time

The three equatorials have been used by M Bigourdan, Mdlle, Klumpke, and M. Boinot respectively, and with them observations have been made of comets, double stars, nebulæ, eclipses of Jupiter's satellites, occultations, planets, and double

M Paul Henry, who is chief of the photographic department, has been bussly cngaged among other things in making large chickit of different regions of the sky, several of which were prepared at the request of foreign astronomers.

The most unportant addition to the Observatory for the year

' "Rapport Annuel sur l'État de l'Observatoire de Pans pour l'Année 1890." Frésenté au Conseil par M. le Contre-Amiral Mouchez (Paris: Gauther-Villars et Fils, 1891)

NO. 1125, VOL. 44]

was the special service for stellar speciroscopy, which, as we have mentioned before, is superintended by M. Desiandres, have mentioned before, in superintended by M. Desiandres, outmost value to science, and the results obtained will be looked forward to with interest. With regard to this branch Admiral Monchez has given an extract from M. Desiandres' report on

After a short description of the meteorological work carried After a short description of the meteorological work carried to, together with the various other reports untailly inserted in this pumphlet, Admiral Mouches concludes with a brief reference to the Observatory School at Monisoarts, of which also he is Director. This school was organized under the patronage of Prance of a school for practical surriously, where "furnities officers, explorers, professors of science, and others could come and accustom themselves to make observations" Since the officers, explorers, professors of science, and others could come and accustom themselves to make observations? Since the year 1877 the Observation? has been freely opened to anyone, the only conditions being that those who go should have sufficient scientific knowledge to understand what is taught, and that there work should be regular "Doy we an idea of the range of the subjects that form the syllabus of instruction we caused the best term and the subjects that form the syllabus of instruction we caused bester that condense the methods of organizations as given in the

better (name conservations), both theoretical and practical report.

With regard to astronomy, both theoretical and practical lectures are given twice or three times a week. M. Bottel delivers a course on electricity and inagnetism which extends over four months, during which time the conducts the officers over all the large electrical manufactories in Paris. Lectures with the large electrical manufactories in Paris. Lectures them with practical instructions for the determination of the magnetic elements M. Thoulet treats of ocean geographic in a course that is of interest and use to sailors. The regulation of the compass, so important to day on account of our iron ships, forms the subject of a number of lectures by M Caspara, while photography is studied for two months under the superintendence of M. Guenaire

From this syllabus it will be seen that a good, practical, and sound course to open to all those who wish to take advantage of it, and in the list of explorers who have figured in the principal missions during the last fifteen years the majority will be found to have served at any rate a short period at the Observatory

In concluding his remarks, Admiral Mouchez, after referring to the school that was started in 1879, and which was suppressed some years after for reasons of economy, points out the necessity of giving every encouragement to the one that is doing such good work at Montsouris W I. L.

NOTE ON THE PHYSIOLOGICAL ACTION OF CARBON-MONOXIDE OF NICKEL [NI(CO),]

DY the kindness of Mr Ludwig Mond, we have had the opportunity of examining the physiological action of car-bon-monoxide of nickel, a substance of unique chemical com-position, represented by the formula Ni(CO). The general results of our investigation are as follows.—

(t) Ni(CO), is a powerful poison when injected subcutaneously

into a rabbit weighing I 5 kilo even with a dose of 1/30th c cm.
(2) The vapour of Ni(CO), in air, even to the extent of 0.5 per

cent, is dangerous.

(3) The symptoms are those of a respiratory poison, and are similar to those caused by carbonic oxide

similar to those caused by carbonic oxide
(a) The spectrum of the blood of an animal poisoned by
Ni(CO)₄ is that of carbonic oxide-hæmoglobin, and it is not
reduced by sulphide of ammonium.
(5) When the substance is injected subcutaneously it is

(5) When the substance is injected subcutaneously it is probably in part dissociated in the tissues, as there is evidence of the existence of nickel in those tissues, but the nickel also finds

the existence of nickel in Inose issues, but the nickel also made its way into the blood, and is found there.

(6) The substance produces a remarkably prolonged fall of temperature even when given in small quantities. In several instances, with lethal doses, the fall was from 2° to 12° C. This may be accounted for by the harmoglobin being prevented to a large extent from supplying the tissues with oxygen. Nico, as we may, for convenience, call this substance, makes it possible to give graduated doses of carbonic oxide, and thus reduce temperature

By John G. McKendrick, M.D., F.R.S., and William Spodgraus, M.A. M.B., Physiological Laboratory, University of Glangow.

by directly interfering with the responsion y axchanges occurring in the tissues. The objections to its set as an an antisyruct see that, owing to its posionous properties, it is difficult to inject it subctaincously in sufficiently small does, while it is not easy to obtain a solution in any meastrium in which decomposition will not take place. If a convenient method of disadving it could be devised, Ni(CO)₄ might become a valuable antipyrette, the median operation of which is intelligible.

SOCIETIES AND ACADEMIES.

Chemical Society, April a.-Mr. W. Crookes, FRS, Voce-Prendent, in the chair, --The following papers were read; and Citraconfluorescein, by J. T. Hewitt Lunge and Burchinave shown that maleu anhydride is capable of yielding a disportecion, the author has obtained the corresponding fluorescein. In earther his contraction of the contract fluorescent, the author has obtained the corresponding more rescent from citraconic anhydride, by the action of resortinol in the presence of sulphuric acid. Citraconfluorescent is easily soluble in alcohol and glacial acetic acid, fairly soluble in water, the aqueous solution is yellowish-brown and shows a green fluorescence — Ethylic thiacetacetate, by Dr. C. T Sprague Hubner obtained ethylic thiacetacetate by the action of sulphur Haber obtained eithylic thacetacease by the action of sulphur monocolloring. Secf., on enthylic accessedate. It has seen been monocolloring. Secf., on enthylic accessedate. The assess been eithylic accessestate, by Schunbrodt by the action of sulphur on the copper derivative of chipic accessenate, and by Michaelia and Fhilips from though chloride and eithylic accessestate, and by Michaelia and Fhilips from though chloride and eithylic accessestate, and the product accesses and the product of the composition of the accesses and the product of the internative formula, SQC C-CH (CQ,BL), was suggested by Delista. The author describes the preparation of the substance and the product of its interaction with hydramics; and shows that it behaves towards phenylhydrazine in the same manner as ethylic acciacetate. The results are in accordance with the formula proposed by Buchka.—The function of chlorine in acid chlorides as exemplified by sulphuryl chloride, by H E. Armchlorides at exemplined by sulphuryl chloride, by 11 E. Arm-strong A number of experiments carried out during recent years in the author's laboratory show that sulphuryl chloride, SQC/L, acts to hencenoid compounds simply as a chlorinating agent. Sulphuryl chloride is easily formed by the direct union of sulphur dixtude and chlorine in the presence of a catalyst, such as camphor, charcoal, or access cald, it is a highly mobile such as camphor, charcoal, or aceira said; at it is a highly mobile liquid of low boiling-point, and its steed on with extreme alow-ness by water and alkaline solutions. It is an meri substance of the point of the special activity, and is inclined to the wew that the activity of each chlorides is conditioned by the oxygen rather than the chlorine, this view being supported by the observations of Wagner and Saspiter, and the last one one of Paulow (Amalian, classivity 104). The sutton sales discusses the action of SQ_11C(1), and the analogous compound SQ_12C(1) and points out that pyromidplary chiloride, SQ_1C(1), behaves much as if it comisted of control of the the formation of a hright yellow derivative of lignone and pitrous acid On further interaction, large quantities of introus oxide, N_sO, are evolved, together with carbonic anhydride and a small proportion of nitric oxide A sensible quantity of hydrogen cyanide is also produced, the proportion being increased by increase of temperature. The observations point to the entrance of the NOH residue into the lignone molecule, its interaction with nitrous acid being finally the displacement of H, by O. The reaction is probably general for compounds containing the NOH residue, and the authors suggest that attention be paid to the gaseous products of the interaction of unitic acid and carbon compounds, as calculated to elucidate their mechanism.—The Chairman, Mr. Crookes, gave a short verbal account of observations on the volatilization of metals in vacuo under the influence of an electric discharge.

This investigation was carried on during last winter. It appears that M Hannoi made a communication of the subject to the Societé Chimique on February 97. He found the substance to be more poleopous than CO, and that the blood gave the spectrum of carbon-monoxide-hamnoglobin.

NO. 1125, VOL. 44]

April 16 .- Prof. A Crum Brown, F.R S , President, in the the chair.—The following papers were read.—Studies on the chair.—The following papers were read.—Studies on the chair.—The following caperns were read to the chair of the cha solution of diorthonitrophenol at ordinary temperatures, the normal product, namely parabromdiorthonitrophenol, is obtained However, if the mixture be hented at 100 for a short time. a mixture is obtained consisting of parabromdiorthonitrophenol and orthobromorthoparadinitrophenol. And if the heating be prolonged, and small quantities of bromine added, the mixed Prolonged, and small qualitates of bonning and an approached is converted into orthobromorthoparadintrophenol. Parabromdiorthonitrophenol is therefore completely converted by the action of heat, and bromine into the isomeric ortho-hromorthoparadinitrophenol. The same isomeric change takes place under the influence of nitric acid. An acetic acid solution of parabromdiorthonitrophenol, when heated with a few drops of orthobromorthoparadinitrophenol Experiments were then under taken with the corresponding chloro-compounds. It was found taken was nie corresponding chloro-compounds. It was found that chlorine had no action out dorthontrophenol when dissolved in acetic acid at 100°, even in the presence of todine Chlorination, however, takes place when chlorine is paved into a solution of dorthontrophenol in antimony pentachloride at 105°, and only the normal product parachloridintrophenol is formed Action of bromme on farachloridirethontrophenol—fixperiments to accertain whether twomers change could be effected. by the action of bromine on parachlordinitrophenol only gave negative re-ults, the normal product, parachlororthobromothonegative results, the normal product, paraconoromotoromotoromotoring introphenol, being obtained in every case. The author considerathat in the case of the chlorine compound homeric change does not take place, because the chlorine is more firmly held than browning action of sulphieric acid on orthogostalichtorphinal orthoutsplane and The combined action of heat and sulphieric acid on the combined action of heat and sulphieric acid. acid on orthoparadichlorphenoisulphonic acid gave no indication of any isomeric change taking place, although the reaction was investigated under a great variety of conditions of temperature, &c The corresponding dibromphenol also gave negative results, infection there is great variety of continuous or temperature, in the transverse data and the continuous or temperature of the transverse data and the continuous or the transverse of the transverse of the continuous or the conti that the Initial action in both cases is the same, but that the sulphate formed from orthonitrophenol as once undergoes isomeric change, whereas the sulphate from parantrophenol is more stable. The author did not succeed in obtaining any sulpho acid by heating the sulphate from the parantrophenol is a sulpho acid by heating the sulphate from the parantrophenol is a fair valid of the parantrophenol in the parantrophenol is a sulpho acid by heating at a com-half and or the parantrophenol is a com-half and the parantrophenol is a complete the parantrophenol is a com-half and the parantrophenol is a complete the parantrophenol is a complete the parantrophenol in the parantrophenol is a complete the parantrophenol is a complete the parantrophenol is a complete the parantrophenol in the parantrophenol in the parantrophenol is a complete the parantrophenol in the parantrophenol in the parantrophenol is a complete the parantrophenol in the paran at 100. But he outsimed a sizr yield of sulpsio acid by nearing the introphenol with two indecidar proportions of SO, [4Cl at 100" Hence, there is little doubt that the parantirophenol establishme acid is formed by the sulphonation of the sulphonate acid is formed by the sulphonation of the sulphonated Metantirophenol receibles the para compound in being converted also sulphate, but not hit to the sulpho-acid even by the action of the sulphonation of the sulphon verted mit sulphace, but not little vulpha-scall even by the action of heat.—Compounds of destrore with the oxides of nuclei, chromuns, and non, by A. C. Chapman, The nuclei compound is not being the proposal and continued by adding a solution of nucleic hydraie in a special more proposal substance, instabile in water and skeohol, of the composition $C_{\rm HI}/Q_0$ 2 May 0.9 + 3 H₀. The chromium compound, which appears to have the composition represented by the formula $C_{\rm HI}/Q_0$ 2 m/s, $C_{\rm HI}/Q_0$ is repeated by the formula $C_{\rm HI}/Q_0$ 2 m/s, $C_{\rm HI}/Q_0$ is repeated by the formula cells of $C_{\rm HI}/Q_0$ 2 m/s, $C_{\rm HI}/Q_0$ is repeated by the formula cells of $C_{\rm HI}/Q_0$ 2 m/s, $C_{\rm HI}/Q_0$ is repeated by the formula cells of $C_{\rm HI}/Q_0$ and $C_{\rm HI}/Q_0$ in the present of the composition into cold strong ammonia. The precipitated hydrid parily showled on standing, and so powing the purple solution to obtained mit to poper cells. Alphololy, the chromated destrowate a obtained as a historical collection of the composition of the compos coloured precipitate. The iron compound, 2C.H15Os.3Fe3Os

PAGE

+ 3H,O, is obtained by adding a slight excess of ammonis to a solution of ferric chloride containing an excess of destrose; on attaining, a deeper dolution so blanked, which when poured into 90 per cent. alcohol yields the destrosets of sroot as a red forculent precipitate. This most compound dissolve easily is decoulent precipitate. This most compound dissolve easily is decoulent the properties. The most is more decomposed by ammonis, potassic ferrocyanide, or potassic decomposed by ammonis, potassic ferrocyanide, or potassic decomposed by ammonis, potassic ferrocyanide, or potassic hidocyaniac. The day compound is unsoluble in water.—A rapid method of estimating principle of the reduction of intrict to Harrow. The method depends on the reduction of intrict to very dilute solution, in the presence of a nephthylamine and supplante acid; the estimation is made by comparing the depths of the past associations developed in the solution with that turing on similar restatents of standard nature solutions, artificial control of the solution of size dust, and due allowance is subsequently made. A number of comparisons with the manner prior to the addition of sue dust, and due allowance is subsequently made. A number of companisons with the Crum method show that very satisfactory results are obtainable. —The "gravitonimeter," an instrument by means of which the observed volume of a ningle gas gives directly; the weight of the gaz: a preliminary note, by F. R. Jepp, F. R.S. The suchor desertion as method of constructing a gas apparatus, by means of desertion as method of constructing a gas suparatus, by means of desertions a method of constructing a gas suparatus, by means of desertions a method of constructing a gas suparatus, by means of desertions a method of constructing a gas suparatus, by means of desertions a method of constructing a gas suparatus, by means of desertions are considered as a superatural desertion of the construction required single gas may, without observation of temperature or pressure and without calculation, be measured under such conditions that each cubic centimetre represents a milligram of the dinons that each cuiuc centimetre represents a milligram of the gas. The author describes the apparatus in deal and the method of sung it, and he saticipates that it will, at least, give most of the saticipates that it will, at least, give most of the saticipates that it will, at least, give most of the saticipates that it will, at least, give most of the saticipate of pressed by the following equations -

present by the following $_{2}C_{2}H_{2}NCS+6C_{5}H_{4}O_{5}=(C_{2}H_{5}NH)_{5}CO+3(C_{2}H_{5}O)_{5}O+2H_{2}S+CO_{5}$

 $(C_1H_1NII)_2CO + 2C_2H_4O_4 = 2C_4H_4NH_4 + (C_4H_2O)_2O + CO_4$ -The action of aluminium chloride on benzenold acid chlorides. by R. E Hughes, Jesus College, Oxford The author has ex-amined the action of aluminium chloride on connamic and hydrocinnamic chlorides, in the expectation that pentamethylene derivatives might result. The experiments, however, afforded negative results. The chloride was either dissolved in or mixed with light petroleum, and aluminium chloride then added; action set in at 80-90° in the case of cinnamie, and at 50° and more briskly in the case of hydrocinnamic, chloride The chief product in both named case of nyarocanamic, caloride the cases was an ill-characterized substance, which has not been examined. The author also describes the following compounds: hydrocanamic chloride, hydrocanamide, and hydrocinnam nydrocinname entorice, pydrocinnamide, and nydrocinnami anillide. It is noted that benzoic and eninamie acids may be readily separated by treating the mixture with phosphorus pentachloride and distilling the product under reduced pressure; the portion passing over below 95' under 10 mm, contains the benzoic chloride

PARTS.

Academy of Selences, May II—M. Duchartre in the chair—Essay on graphical dynamics, with reference to the periods of motion of bydraulic motors, by M. H. Léauté.—On the lowering of the surface of water in a horizontal cylindrical vessel, by M. Hatou de la Goupilière.—On the boundaires of the litteral zones, by M. Léau Vaillant—Observations made at Marseilles Observatory of the asteroid (98) discovered on March 31, by M Borrelly The observations for position extend from April 6 to Appl 30 — Elements of the orbit of Borrelly's new asteroid (see), by M. Fahry. - Provisionary elements of Borrelly's asteroid deticed from observations made at Marsellie Observa-tory on March 30, April 8, 18, and 26, by M. Esmol.—Solar observations made at the Royal Observationy of the Roman College during the first quarter of 1891, by M Tacchini.— —On the movement of the moon's perigee, by M Perchot. —On limited permutations, by M. C. A Laisant.—On a class

of complex numbers, by M. Markoff.—On a registering manometer applicable to pueces of ordnance, by M. P. Vieille.—An "clastic "theory of plasticity and fragility of soil bodies, by M. Marcel Brillouin.—On the wave-unrice in crystals, by by M. Marcel Brillouin.—On the wave-unrice in crystals, by by M. Marcel Brillouin.—On the wave-unrice in crystals, by by M. Marcel Brillouin.—On the wave-unrice in crystals, by M. Blondlot. The anthor has made some experiments which support Prof J. J. Tomonets conclude in the interpolation, by M. R. Blondlot. The anthor has made some experiments which support Prof J. J. Tomonets conclude in the time of the desired of refrection, and has least value when a slow frequency of refrection, and has least value when a slow frequency of refrection, and has least value when a low frequency of refrection, by M. E. Pfehnet.—Thermic ratory of bibasic organic aware, by M. J. Toulet.—On the fourth primary supplication, by M. I. Toulet.—On the fourth primary supplication, which is the control of the control of the processing of the control of the contr —The parasitic rungui of the sarva of the cockenaer, by and re-Prillieux and Delacotus.—The parasite of the cockenaer, by M. Le Moult.—On a remarkable inversion of strais termed /bi-count/d observed near Toulon, by MM Marcel Bertrand and Zurcher—On the permanence of the orogenic effort in the Pyreness during the geological periods, by M. Roussel.

Royal Academy of Sciences, April 24.—Prof. van de Sande Bakhuyzen in the chair —Mr van der Waals dealt with Sande Sakhuyzen in the chair—Mir van der waais deau wint a formula for electrolytic dissociation, which may be deduced from his theory of a mixture. This formula accounts for the facts: (1) that ions may combine with absorption of heat; (2) that the parameter of electrolytic dissociation varies with the medium which holds the salt-molecules in colution; (3) that the quantity of free ions may diminish when the quantity of salt-molecules increases

CONTENTS.

Pycnogonids. By E. P. W.	49
A Text-book of Chemistry based on the Periodic	
System	50
Our Book Shelf:	
Roberts . "Eighteen Years of University Extension"	52
Hepworth "Evening Work for Amateur Photo	-
graphers"	52
Letters to the Editor :-	-
The University of London Question -W T Thisel-	
ton Dyer, C M G., F R.S., F Victor Diekins	52
Co-adaptation,-Prof. George J Romanes, F.R.S.	55
A priors Reasoning Prof George Henslow	55
The Natural Selection of Indian Corn -T. D A	JJ
Cockerell	56
The Soaring of Birds. (With Diagrams)-S E	30
Peal	56
On some Points in the Early Hlatory of Astronomy,	-
III. (Illustrated.) By J. Norman Lockyer, F.R.S.	57
Forestry in North America. By Prof W. K. Fisher	60
Daily International Weather Charts	62
Joseph Leidy, M.D.	63
The Science Museum	63
Notes	65
Our Astronomical Column:	-3
The Photography of Faint Nebulæ	60
Variations in Latitude	60
Re-discovery of Wolf's Comet (1884 III.)	60
The Paris Observatory, By W I. L.	70
Notes on the Physiological Action of Carbon-	,,
Monoxide of Nickel By Prof. John G. McKen-	
drick, F.R.S., and William Snodgrass	m

THURSDAY, MAY 28, 1801.

MEDICAL RESEARCH AT EDINBURGH Laboratory Reports of the Royal College of Physicians of

Edinburgh, Vol III (Edinburgh and London Young J. Pentland, 1891)

OW that for three years the laboratory of the Edinburgh Royal College of Physicians has shown steady advancement in every direction-in the number of workers engaged within it, in the volume of work accomplished, and more especially in the quality of that work-Dr Grainger Stewart and his Council must congratulate themselves heartily that they were undeterred by any misgivings from entering upon a venture which has been so abundantly successful, and which has added so much to the renown of the College. It must be a source of very sincere satisfaction to them, and especially to Dr Batty Tuke, the prime mover in its organization, to know that no laboratory in the Kingdom can show for the same space of time a record of so much good work in so many directions, of which a large part would never have been undertaken had this laboratory not been established

In many respects the present volume exhibits marked improvement as compared with its predecessors. While composed of more than a dozen papers, these only represent but a portion of the investigations that have been completed, and all of them contain matter of permanent interest, others whose interest is of a more temporary nature have, I think wisely, been excluded The value of the volume is further enhanced greatly by the fact that the majority of the reports appear here for the first time Among these may be mentioned Dr. Helme's important contribution to the physiology of the uterus, Di Gulland's heterodox papers upon leucocytes and adenoid tissue: Noel Paton and Balfour's very full studies upon the composition and physiological action of the human bile; Woodhead and Cartwright Wood's observations upon bacterio-therapeutics; and a short but important communication by Cartwright Wood and Maxwell Ross on the influence which the process of inflammation exerts upon the course of infectious disease Taking these in order, Dr Helme's paper is of especial

value, not only clinically, from the light it throws on the mode by which certain drugs act upon the uterus, and from the consequent indications it affords as to the conditions under which they may wisely be administered, but also as a contribution to the physiology of non-striped voluntary muscle. Employing the uberlebende organ the organ removed with all precautions immediately after the death of the animal (a sheep)-and continuing the circulation through it artificially, Dr. Helme has been able to study its slow rhythmic contractions apart from the influence of the central nervous system and of the changes in the blood supply From a physiological point of view, his most important observation is perhaps that which brings out the striking difference existing between striped and non-striped muscle as regards the relationship between contraction and blood supply striped muscle during contraction becomes hyperæmic, the uterus, the largest mass of unstriped muscle in the body, becomes during contraction relatively anæmic.

It is impossible to pass Dr. Gulland's articles upon the nature and varieties of leucocytes and upon the development of adenoid tissue without bestowing on them not a little adverse criticism, and this, while appreciating fully the long months spent in laborious preparation and examination of tissues, and in studying the literature of the subject, of which they bear ample witness. That Dr Gulland bases his conclusions upon the view that the leucocytes are symbiotic, and shows at the outset that he totally misconceives the nature of symbiosis, is quite sufficient to render fuller criticism of his views unnecessarv Yet, that it may not be said that I misrepresent his views, it may be as well to quote his words upon this súbiect ·-

"There are still" (in the Metazoan) "many functions to be performed which can only be discharged by cells possessed of Protozoan characteristics. these functions it is necessary that a certain number of cells should continue to be practically Protozoa, and these cells are what we call 'leucocytes,' so that we may regard them morphologically as representing those members of the primitive Metazoan colony which escaped differentiation, and have remained unaltered Protozoa through the whole series of Afetazoa" (the Italics are mine)

Such inconsequent theorizing goes far to neutralize the minute and careful observations which Dr. Gulland has

made into the histology of his subject

That the formation of hile solids is more closely associated with the general metabolism than with the changes of digestion is the conclusion drawn by Dr. Noel Paton and Mr Balfour, though somewhat unexpectedly they find that in fever, where the general metabolism is greatly increased and the digestive processes reduced. the amount of bile solids excreted is diminished studies of cases of biliary fistula in man are of value, and such full observations as those here described are rare Of drugs they find calomel and salicylate of soda active in increasing the flow of bile. Whether they are right in looking upon the bile as an excretion, rather than as at the same time a secretion playing an essential part in digestion, is open to doubt Even if with bile excluded from the intestine only 30 per cent of the fats ingested pass out unused that nevertheless is a proportion large enough to demand consideration, and to support the assumption that as a secretion, as well as an excretion, the bile is of definite importance The ingenious method devised for the estimation of the bile pigments (p. 197) deserves a more extended trial.

At a time when Koch's endeavours to cure tuberculosis by means of injections of products of growth of the tubercle bacilli have brought the whole subject of bacteriotherapeutics prominently to the fore, the full discussion of this by Drs Woodhead and Wood is very acceptable, based, as it is, upon their own important discovery that the invasion of the organism by the bacillus of anthrax may be prevented by injections of the sterilized fluid in which the Bacellus pyocyaneus has been grown. Space forbids that I should do more than indicate that those interested will here find a full account of our present knowledge of a subject which is occupying the energies of every leading bacteriologist

Of allied interest is the communication by Dr. Wood and Mr. Ross. It has long been known that the advance of erysipelas can often be successfully combated by panting the skin immediately outside the crysipelatous area with some counter-irratant. The authors have studied the rationale of this treatment, and conclude that the Irritant berniga about the formation of a tone of inflammation, with dilatation of the vessels and dispedess of the white corpuscles, which now, by destroying the micrococca, act as a barrier to the further progress of the disease. With the malignant pattle produced by the inoculation of the anthras bacilli, similar counter-irritation was effectual in only three out of thry cases—that is to say, with the more active virus the stimulus applied was not sufficient to produce an effectual barrier. J GEORGE ADAM.

THE CHEMICAL AND BACTERIOLOGICAL EXAMINATION OF POTABLE WATERS.

Examen Químico y Bacteriológico de las Aquas Potables Por A E. Salazar y C Newman, con uno capitulo del Dr. Rafael Blanchard sobre "Los Animales Parásitos introducidos por el Aqua en el Organismo." (London · Burns and Oates, 1890)

PECULIAR interest attaches to this work at the present moment in consequence of the sad political events now going on in the country from which it has emanated; for, whilst almost each successive day brings news of the sacrifice of human life in one of the fiercest and most sanguinary civil contests of recent years, the object of this book is to show how the latest results of scientific research may be applied to combating on the same soil some of the ills which flesh is heir to. The publication of this treatise for Chilian students affords the strongest evidence of the rapidity with which scientific knowledge traverses the globe at the present day, and it must be a source of great satisfaction to all interested in the dissemination of the principles of hygiene that there should be a demand for a work of such an advanced character in a country so remote from what we are wont to regard as the centres of civilization

The scope of this work is more comprehensive than that of perhaps any similar one in our own language: English treatises on water analysis being in general only short manuals giving instructions for the execution of analytical methods devised by their authors, who usually dismiss the rival methods of others with a few words, often not of a very complimentary kind The pages under review, however, not only give an interesting account of the various methods employed by water-analysts, but subject their several claims to a fair and impartial criticism, whilst detailed information is supplied for carrying out those methods which the authors regard as, on the whole, the most serviceable. Again, a most exhaustive account is given of the bacteriological examination of water, including precise instructions for the cultivation of micro-organisms, the preparation of nutritive media, the sterilization of apparatus, the use of the microscope, and the performance of inoculation experiments on animals. But even this ample programme was inadequate for the ambition of the authors, who have associated with themselves a third colleague, who contributes a bulky appendix on "the animal parasites gaining access to the organism through water." The work is not only profusely illustrated with cuts, but contains also a number of ori-

ginal photographs representing both the microscopic and macroscopic appearance of some bacteria. Indeed, the bacteriological part is the real centre of gravity of the work. A decade will soon have elapsed since the bacteriological examination of waters began to attract much attention in consequence of the ingenious method o gelatin-plate cultivation devised by Koch It was not, however, until some years later that the method yielded results of any practical importance, masmuch as it was at first almost exclusively applied by bacteriologists whose previous information on questions of water-supply was of a somewhat limited order, whilst the value of the method for the solution of many hitherto unsolved problems connected with the hygiene of water is even now but imperfectly appreciated by chemists. When the method was first applied to the London water-supply, in the year 1885, it at once brought to light that in the process of sand-filtration, as practised on the large scale, a most astonishing proportion of the micro-organisms present in the unfiltered water were removed, whilst in the best of our deep-well waters the number of microbes found was so small that it seemed probable that the removal of these low forms of life in this process of natural filtration was really complete, and that the few actually found had very likely been imported into the wells from the surface On the other hand, it was shown that the sand-filters did not wholly remove the organisms present in the unfiltered water, as, in the course of regular examinations carried on over a period of more than three years, a most unmistakable relationship between the number of microbes present in the unfiltered and filtered waters respectively was discernible. The scope of the bacteriological method of examination became very much narrowed when it was discovered that there are many micro-organisms which have the power of multiplying to an enormous extent in the purest waters, including distilled water itself, so that the number of inicrobes present in a given sample of water affords no indication per se of the purity or otherwise of the water. This disturbing element in the bacterioscopic examination of water is not sufficiently emphasized by the authors. But this extraordinary phenomenon of multiplication, although it invalidates the bacteriological process for the general purposes of water examination, does not at all interfere with its successful application to the investigation of the efficiency of filtration, either natural or artificial, provided that the filtered water is subjected to examination without delay after it has undergone the process of filtration

It should be pointed out that there exists a very widespread misapprehension as to the ideal object of the bacteriological examination of waters, and the authors of this work fail into the same error to some extent also. It is very generally supposed that the main object of a bacteriological examination is to discover whether or not there are disease-producing organisms, e.g. those of typhoid, in the water. But this is a point really of very limited importance, and what should be kept in view in an examination of water is the endeavour to discover, not whether the water contains symotic poison at the time of analysis, but firstly, whether it is exposed to influences which may at any time lead to the introduction of such symotic poisons, e.g. through contamination with swange; and secondly, whether, if such organized poisons should gain access, there is any sufficient guarantee or not that they will be destroyed or removed before the water reaches the consumer. It is because the chemical analysis affords us at present a better clue than the bacteriological examination as to whether a water has received sewage or not that it is of more general applicability than the latter; but we must appeal to a bacteriological inquiry in order to ascertain whether, in the event of sewage gaining access to the water, there is a guarantee in the subsequent history of the water that the zymotic poisons, which may at any time accompany the sewage, would undergo removal In short, the object of nearly all water examinations is obviously to ascertain whether the water may at any time be dangerous to health, and not, even if this could be with certainty determined, whether it contains a zymotic poison at the particular moment of examination. On the other hand, the fact that the microbe, which is now pretty generally accepted as the inducing cause of typhoid fever, has been on more than one occasion actually discovered in drinking-water which was under suspicion of producing an epidemic of that disease, affords most important evidence as to the manner of its distribution

There is much need of a similar work to this in English, as each year an increasing number of younger medical men are coming forward for the degrees in Public Health which are now granted by several of our Universities, and to these a practical and critical treatise such as this would prove of great value It is of great importance that such Public Health students should be impressed with a sense of the responsibility which attaches to the examination of waters for domestic purposes, and that most serious mischief may and often does result from such investigations being intrusted to incompetent persons. It is gratifying to see that the authors do not undertake to prescribe any of those artificial standards of purity for drinking-water which so frequently figure in books of this kind, and which are attended with the greatest danger, leading as they do the ignorant to believe that they can pronounce upon the fitness or otherwise of water for drinking purposes from the numbers which they have obtained in a few simple quantitative determinations For it must never be forgotten that the sanitary examination of water is surrounded with such difficulties that it is only by bringing to bear on each particular case all the evidence that it is possible to obtain, and then interpreting this evidence by the light of an extended experience, that a sound judgment can be arrived at P F. F

OUR BOOK SHELF.

Botany a Concise Manual for Students of Medicine and Science. By Alex Johnstone, F.G.S. (Edinburgh and London: Young J. Pentland, 1891.)

DURINO recent years many books on botany have been published, specially for the use of students preparing for examinations. In these a few types and phases of plant life have been described somewhat in detail. In the present case a much wider range has been taken, the result being an illustrated botancial note-book, condensed but not meagre. In the preface the author takes it for granted that every student nowadays attehis fectures

or demonstrations, and "therefore does not so much require a manual with diffuse explanations, but rather a kind of illustrated digest and general note-book, which will enable him to quickly arrange and make most effective use of the various facts and set of the various secessful in producing It consists of 260 pages and 2:56 illustrations. Some of the latter are the ones which seem by cates to the considered necessary for reproduction in every fresh abouncal manual, white others appear to be refresh boancal manual, white others appear to be represented by the second of the second section of the producing of cells, give a much clearer idea than could be done by pages of letterpress. A short introductory chapter points out the position boansy holds in science. The strictly botanical part of the work is treated of in or veranoratiny. (1) physiology, and (6) laxonomy

consequency and the consequency of the general consequency of the cons

The arrangement throughout the book is good The various headings, &c, printed in type differing according to their importance, have been very carefully set out, and give a good resumé of botany in a tabular form As an illustrated note-book for a teacher, as well as a student, this work will be found of great use C H W.

Hand-book of the Ferns of Kaffraria. By T R Sim, Curator of the Botanic Garden, King Williamstown, South Africa 66 pages, 63 plates (Aberdeen Taylor and Henderson, 1891.)

THI's little book contains popular descriptions and outline plates of the ferms of Kaffrain, with a chapter of definitions of the botanical terms used in describing ferns, and another giving directions how to cultivate them. The Cape, considering the general interest and remarkable of the plantened of the control of the plantened of the control of the plantened of the control of

recognizing any of the Kaffrarian species; and perhaps at some future time Mr Sim, who was trained at Kew, will extend his area so as to cover the whole colony, for which the total number of ferns known is between 130 and 140,

Rider Papers on Euclid. Books 1.-11 Deakin. M.A (London: Macmillan and Co. 1891) THIS little book consists of a series of graduated riders so arranged that the beginner may be able to thoroughly understand and grasp the principal propositions of the first two books of Euclid. One of the chief errors that the -author endeavours to avoid is the great stress teachers lay on some of the propositions, which are treated as

most important, while others are more or less overlooked The method he adopts is to treat each proposition first as a rider, and by giving the enunciation and drawing the figure, see if any of the class can show how it is proved By this means the subject can be made interesting, as beginners can then look upon each rather as a puzzle than

as a stiff piece of work

The two books are divided into nine parts, each part consisting of six papers, and the riders in each paper, with the exception, of course, of the first, deal with all the preceding propositions. The student is advised in the first six papers only to draw the figures, in order to accustom himself to one of the chief difficulties which, as the author says, "experience shows me that all students feel more or less in solving riders."

At the end are printed the enunciations of the propositions of the two books, followed by several papers set at various examinations Altogether, teachers will find this an admirable help for classes in which the subject is

Die Krystallanalyse oder die chemische Analyse durch Beobachtung der Krystallbildung mit Hulfe des Mikraskops mit theilwaser Benutzung seines Buches uber Molekularphysik Bearbeitet von Dr O Lehmann (Letpzig Engelmann, 1801)

WE have so recently noticed at length the splendid work of Dr O. Lehmann on "Molecular Physics" (see NATURE, vol xlii p I) that it is only necessary in this place to call attention to this pamphlet of 82 pages, illustrated by 73 woodcuts, in which the author gives the necessary directions for the work of micro-chemical analysis The instruments used and methods employed are concisely stated, and all the essential details of the operations are supplied to the chemist in this little handbook Dr Lehmann claims, not unjustly, that the methods of micro-chemical analysis must play the same part in the laboratory of the organic chemist as spectral analysis does in the laboratory of the inorganic chemist

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions ex-pressed by his correspondents. Nisther can he undertake to return, or to correspond with the worsters of, rejected manuscripts intended for this or any other part of NATURE. No nistice is taken of anonymous communication:

The University of London

My friend, Mr. Thiselton Dyer, invites me, by his references My frend, Mr. Thuelton Dyer, avates me, by haveferences to what I have written on this subject, to a discussion in your columns. I am very unwilling to accept the invitation, because I have already and done stated my verse, and because I see by have already and the state of the

would rescue from proverbial oblivion the pages of careful state-ment entombed in a Blue-book. Since, however, my friend trails his coat, it would be doing violence to my old-established regard

for him to refuse to tread on it—just a little

The question raised by Mr Dyer seems to be, why should not
the examining board in Burlington Gardens undergo certain reforms and continue to be the so-called University of London? It has done good service to education, he says, and with the removal of more than half its members and their replacement removal of more than half its members and their replacement by gentlemen who either really know or really care about University education it might do more. If it were, he suggests, to rise superior to all its most solemn obligations and faisily the pledges of its founders by undertaking to teach as well as to examine, it would really be as much of a "teaching University". examine, It would reary be a final of a teaching a set set ther Oxford or Cambridge, and its non collegiate supporters from all parts of Britain might enjoy the spectacle of the mother-college (University College) from which this examining

mother-college (Unwently College) from which his examining board took birth, shandoning in favour of Burington Gardens those traditions of accentific research which have made the College is some measure a tealitation of Fichte's deal.

[Mr Typer seems to have forgotten the facts when he contends that such teaching as Fichie sketched in his plan for the University of Berlin, cannot be arried on in the same institution. or by the same men who administer the teaching required by a or by the same men who administer the teaching required by a University valued at the commencenneil offsite career. Fichtie's plan was carried out in the University of Berlin, and has been followed by every other University in Germany. The very questions which we are now debating were debated in the early categories. The commence of the commence of the commence of categories which we are now debating were debated in the early categories. The commence of the commence of categories which were contributed to founded (except so far as it was a private enterprise) on the function of a German University, and only required the working and founded (except so in as it was a private enterprise; on the intens of a German University, and only required the privileg and independence conferred by the power of granting University degrees to enable it to fulfil in London Fiche's ideal. Its professors have never been (as Mr Dyer well knows) mere in structors for examination purposes. The researches of Craham, tendro of never need name of the week of the con-lement of the control of the co in Burlington Gardens, on the ground that it is inconsistent with the teaching of University undergraduates, appears to me to involve an erroneous conception of what University education and University organization should be This by way of parenthesis?] The point which I wish to insist on is that, excepting the pro-

posal to undertake higher professorial teaching, I have no objection whatever to the reforms of the examining body in Builington Gardens advocated by Mr. Dyer

What I desire (and I merely use the first person singular for the purpose of discussion, and not because I stand alone in my wishes, or undervalue the support of others) is that, without any of granting degrees should be coaferred by the Crown upon a combined Senate consisting of the Professors of University and King's Colleges (the authority of the councils of the two Colleges

being duly guarded)
The fact that Burlington Gardens are in London and that University and King's College are also in London, as well as the talk about a teaching University "in and for" London, have very little bearing upon the question as to whether it is or is not very little bearing upon the questions as to whether it is or a not desirable to grant. University privilege to the two Colleges. There is population enough and accommodation enough for a state to judge as to the primaples which should quide the Crown in bestowing the privilege of incorporation as a University, the only questions to be saked are "Does the body which asks for only questions to be saked are "Does the body which asks for personal properties of the privilege of incorporation as University, the particular that the properties of the pr now and hereafter? Will the concession to them of this privinow and hereafter? Will the concession to them of this privi-lege tend dructly or indirectly or both to the public welfare?" I cannot imagine that anyone will undertake to give a negative University and Kingh. "Certain it is that during the courte dis-cussion which has been carried on for the last four or five years, no one has wentured to do so. What has happened it simply this, that persons connected with Burlington Gardiens have opposed the between of University powers on the two Colleges, either for the reason that they consider the withdrawal of the either for the reason that they consider the windrawai or the Colleges from the sphere of the operations of the Burlington Gardens examining board a reflection upon that body, or be-cause they are unwilling that a privilege should be conceded to Colleges, however well fitted to receive it, which their own local or provincial college is not yet important enough to claim. A further incident of the movement has been that the just demands of London medical students and their teachers for a University degree in medicine, as readily attainable by London students as are the medical degrees of Fdinburgh, Glasgow, Dublin, Aberdeen, St. Andrews, Durham, and Cambridge, by the students

Neither of these accompaninents of the request for University
powers made by University and King's Colleges seems to me to touch the question as to whether it is right on grounds of public policy to accede to that request. Sir William Thomson, Sir George Stokes, and Mr Weldon after an exhaustive inquiry George Stokes, and Mr Weidon after an exhaustive inspury were in favour of granting the privitige skeld for Three lawyers, namely Lord Sebborne, str James Hannen, and Str James Ball, were not persuaded. The commission composed of these six genilemen agreed to ask the Burlington Gardens authorities to try to devire such alterations in their "University" as would satisfy the aspirations of University and Aings, Colleges Burlington Gardens has absolutely and hopplessly of the problem could foresee must be the case. They have They have proposed a scheme which has not been accepted by the Colleges. and has also been rejected by their own provincial graduates.

Why should more time be wasted about the attempt to put
three pints into a quart bottle? Let the Burlington Gardens University continue to exercise its function of examining for schools and colleges which are not strong enough to examine schools and colleges which are not strong enough to examine for themselves, and let them continue so to do only until the colleges are fit to receive independent University powers, let the Senate reform itself if it can, and if the shurd dead-weight of graduates itted round its neck and called Convocation will of grautates tied round its neck and cause Convocation will permit it to do so. But do let us have in the meanwhile a genuine professorial University set on foot in London, not because it is London, hut because University and King's Colleges are there, and respectfully petition Her Majesty to do for them what the monarch has done (not unwisely, it must be allowed) in past days for the Senatus Academicus of Edinburgh, of Aberdeen, of Leyden, of Beilin, Bonn, Leipzig, and other

What the two Colleges ask for is a privilege—a special favoir To include other institutions as co recipients of the privilege To include other institutions as co recipients of the privace would destroy its character and its value. As Mr. Dyer points out, we do not want a federal University, such as are Cambridge and Oxford and the Victoria. We have seen enough of the and Oxford and the Victoria. We have seen enough of un-frietion and never-ending committees and schedules of such climatily organized Universities. By limiting the charter to University and King's Colleges, a professorial University can be established in which the professors shall be—as in the Scotch established in which the professors shall be—as in the South and the German Universities—a once the teachers, the examiners, and the governing body. I cannot persure what great manners, and the governing body. I cannot persure what great persure the control of the persure that great persure the grea acquire importance by their interface proposity conducting the affairs of the committees and boards in which what is good and strong in each member is counteracted, whilst only le, worthless, and emasculate survive-

The professorial University formed by a union of King's and University would be of modest dimensions, and rightly so. It University would be of monest dimensions, and rightly so, at would in vittee of its charter be able to grow. This I regard as the most important feature in the proposal. Instead of hastily bringing together a variety of teaching bodies, we should leave it to the new University to assimilate them, make terms with them, in the course of time.

them, in the course of time. Though they are modest bodies compared with the Imperial serial Impulsion and the Impulsion of which they seek to be a standing the protein of the Impulsion of which they seek to seating the property and the number of students which they would bring to the new University, which are far larger than the corresponding figures for many other Universities both in the United Kingdom and abroad. Their buildings and land are worth had a sufflion string. Their annual receipt access (2,0,0,000, their 1 sufflion strings. Their annual receipt access (2,0,0,000, their 1 sufflion strings.)

annual attendance of students is as great as that of the University of Oxford. This is an ample basis; with this start the new University would without any doubt be able to ensure a steady

Ufferently would without and doubt be able to ensure a steady growth, increase of its properly seek is teaching capacities, by a healthy and gradual development.

Mr Dyer skildly seek to enlish support for the supremacy of Barlington Gardens by asking the following questions (of which he does not give the answers for obvious reasons) "Why should two out of many institutions be picked out for University honours? Why should Beeford College be left out? How can the Royal College of Scence he ignored? Why ignore the City and Guilds Institute?"

These questions are excisable only when we admit that Mr Dyer may for the nonce treat his defence of Burlington Gardenas a lawyer may treat a shady case entrusted to his advocacy in the courts

The reason why the Crown should pick out the two Colleges The reason why the Crown should pick out the two Colleges for the University privilege; is, firstly, that they and they alone have asked for it, secondly, that they and they alone possess the property, professoriate, states, and historical purpose which could warrant the privilege; and, lastly, that University powers are essentially a privilege fitted and intended to strengthen and are essentially a privilege fitted and intended to strengthen and build up the institution to which they are granted above others leditord College is cared by Mr. Dyer solely, I am afraid, with the purpose of rooting the jestowy of its members. They are, they are the purpose of the purpose of the purpose of the con-traction of the purpose of the purpose of the purpose of the state of the purpose of the purpose of the purpose of the purpose portance to University and King's. As to the Royal College of Science, the answer is different. It is a Government institution under a upscal department founded and current on with a special under a special department tounded and carries on wins a special paperose. It grams its own certificates and fulfills is objects a special paperose of the paperose of the paperose of the carries of the It grants its own certificates and fulfils its objects exercised by Burlington Gardens.

The fact appears to me to be that centralization in University matters is wasteful of time and energy, paralyzing and delianve Two Colleges like University and King's can unite and settle their affain together, and if granted such powers as other Universities possess they may in time take into their organization, partially or completely, other institutions, or arrange methods of co-operation with other institutions. Indeed they would, if incorporated as a University, be sure to do this, and to do it far more efficiently than could be the case were they shrupily associated with a variety of rival corporations, each with equa-rights and equal voice, and left to compromise and to vote through endless committees, either as constituents of a reformed Burlington Gardens University or of a new piece of federal

Burlington Gardens University or of a new piece of resues. Mr. Dyer has swelpt awoude the question of the demand for medical degrees. I confess that this is a very difficult problem on account of the attitude of the medical profession. If the medical profession if the health of the profession is to be allowed to grain medical degrees. On the profession is the allowed to grain medical degrees, the profession is the profession of the medical profession is the profession of the medical profession is the profession of the medical profession in the matter. The thing to be attend at a for remedy medical profession in this matter. The thing to be attend at a for remedy an injustice; it is necessary to provide a degree as accessible as that of other Universities through whatever University or Uni-versities may exist, hereafter, in London.

In my evidence to the Commissioners I made some sugges-tions on this matter. I am inclined to think that the following steps are necessary for a satisfactory solution of the problem (a) the abolition of the medical faculties of University and

King's Colleges—excepting the Professorships of Anatomy, Physiology, Pathology, and Forensic Medicine—and the crea-tion of independent clinical schools attached to the North London and Lincoln's Inn Hospitals; (6) the nomination of a London and Lincoln's Inn Hospitals; (*) the nomination of a medical professoriate for the new University by representatives medical professoriate for the new University by representatives filled up on the recommendation of the Senate of the University, (*) the recognition, under conditions, by the new University, of the clinical teaching in each of the London bospitals, and the admission of students to its medical degrees on conditions. tion of having passed the prescribed examinations of the University and of having pursued not necessarily more than one-half of the entire curriculum under the professors of the University. The University might also be required to re-University. The University might also be required to recognize (in exchange for a like concession) the examinations
in certain subjects of the Conjoint Board as excusing candidates
from like examination by the University.

This is undeniably a complex part of the subject. It would

be simplest, and probably satisfactory in the end, to grant the nower of giving medical degrees to the limited body (King's and University) and to leave it to make such arrangements as it might find expedient with the medical schools of London. The professional feeling of the medical faculties of University and King's Colleges would insure their making an equitable use of the privilege, such as their medical brethren would heartily approve.

E. RAY LANKESTER.

approve.

P. S.—There is one argument put forward by Mr. Dye which
IP S.—There is one argument put forward by Mr. Dye which
trend on. He quotes my opinion that the University may use
fully examine scholar passing from the schools to the University may use
as a test both of the work of the schools by and of the efficiency
of the schoolsmare, and proceeds to minimum that in the same
of University undergraduates, but of their teachers. This is
advanced as an argument in favour of schemal or superior
of superior or superior or superior or superior
or superior or superior or superior
or superior or superior or superior
or superior or superior or superior
or superior
or superior or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or superior
or super advanced as an argument in favour of external or superior examining boarts in University examinations as opposed to examinations conducted by University professors with associated external examiners. Mr. Dyer has, however, omitted to cite the reply which I had siready given to his specious argument, the contract of the reply which I had siready given to his specious argument, which is the simple size of the reply which I had siready given to his specious argument, which is the size of the size work of the Senate of Burlington Cardens. Eather University professors are workly to occupy their positions or they are notion bigher branch of the educational profession exists. To correct them by means of Senates composed of retired teachers and distinct of Senates composed of retired teachers and distinct of the control of the cont

If we are to have an intensite series of authorities one above the other, who, one would like to know, is to control the examining board which sits over the professors? And who

again to control these controllers?

The bureaucratic machinery which seems to find favour with Mr. Dyer is, in my opinion, superfluous The most efficient Universities (in two differing directions), those of Germany and of Scotland, have no authority in educational matters above that of the professoriate, and are not subject, like Oxford, Cambridge, and London, to the interference of graduates in the form of convocation

MR. THISELTON DYER appears to think that Fichte's ideal of a University is unrealizable, unless, as he supposes, "some wealthy man gives, say, half a million to found such a University in some quiet country town in England, where professor and

pupils might labour together, andisturbed by the life and movement of a big city, or the worry of the examination-room, for the advantage of knowledge." I venture to think that this sup-position of Mr. Thiselton Dyer's conveys the unwelcome truth position of Mr. Thueston Dyer's conveys the unwescome transitatine conception of the true nature of a University has not yet reached some even of that section of the British public who have earned well-merited distinction in science, and it is as one of the control of the Scottleh and a German University, have earned wein-merited distinction in science, main a is as one who has had experience of a Scottish and a German University, in the character of student and teacher, and of two English University Colleges as teacher, that I ask permission as abortly as I can to place before your readers what many minds aim at, in the hope that a teaching University in London, call it what you will, would ultimately provide it.

I resterate the assertion which I jately made in a letter to the

I reterate the assertion which I lately made in a letter to the Timet, that a University is primarily a place for the extension of the bounds of knowledge, this is to be achieved by the labours of the professors and teaching staff; by fellows, specially appointed for that purpose, if the system of fellowships is thought desirable, although, in my opinion and experience, much may be said against it, and by the whole body of the students. Of course is not to be supposed that every student students. is capable of discovering new facts or of applying principles in an original manner, but almost every man is endowed with some share of inventive faculty, which must ultimately be developed. if he is to make his way in the world otherwise than as a daylabourer, or as a piece-worker in a factory, or as a copying-clerk; and the object of a University should be to cultivate this cierk; and the object of a University should be to cultivate this faculty to the utmost. An efficient medical man spends his life in clinical experimentation; a successful barrister exercises his ingenuity in applying old decisions to new cases, a competent engineer not merely studies how to improve his machinery, but also studies his fellow-creatures, and the chances of trade, so as faculty is not developed at the University, it will be developed later, in every man who fulfils his duty to his fellow-creatures and to himself.

and to numseii,
Now I dare to contend that the degree-stamp of the English
Universities, especially of the University of London, except in
certain cases in its highest degrees, such as the D.Mus, D.Litt,
M D, and D Sc degrees (and these only as a result of recent
modifications), is of no value whatever in the eyes of that modifications), is of no value whatever in the eyes of that portion of the public whose opinion carries with it a commercial reward. Speaking for mysell, I have had assistants, graduates of Edinburgh, of London, and of German Universities, and I unhe-statingly state that the only degrees to which I should attach the leax importance are those of Germany, and that because there is in them some evidence that the graduate has had. as least an initiation into the methods of research. As this assertion may be applied personally, I should wish it to be clearly understood that I have no reason whetever to be in any way dissatisfied with graduates from Edinburgh or from London, way disastisfied with graduates from Edinburgh or irom London, that merely to take that the fact of their being graduates in no way influenced me in their appointment. And many manifecturers, in want of assistants, actually regard an English degree in the light of a disqualification, so that most of the posits of "works-themists" are held by non-graduates. They prefer, in fact, to train their own men—that is, to give them such an education in research as hears on the particular problems which they themselves have to solve, or to take them from the laboratories of general analysts, where new problems present themselves from time to time,

themselves from time to time.

It is suppossible, under existing circumstances, to give underIt is unjoachie, under existing circumstances, to give underThey judge from the standpoint of "Will this 'pay' at an
amaniance?" And they cannot be blained it is not the fault of
knowing?" And they cannot be blained it is not the fault of
the standard of the standard of the standard of the standard of
the standard of the standard of the standard of
the standard of the standard of the standard of
the standard of the standard of the standard of
the standard of the standard of
the standard of the standard of
the standard of the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard of
the standard o value, except in the eyes of school teach hers. Personally I canvalue, except in the eyes of school teachers. Fernonally I call-not complain that I do not get research done by students; in sextual fact a considerable number do stay after graduation, and some do not graduate at all. I merely hold the opinion that the method is on wholly wrong lines; that a degree, if given, should be the official testumory to a certast time speat with diligence and profit in guning knowledge useful for the purpose in-problems—of how to equite knowledge useful for the purpose in-

It will be said that honours-degrees will find no place in such

a system. Why should they? Does the desire to beat com-

position stimulate a desire for knowledge? Does it stimulate originality? I to one would willingly set them non-exament. Up to a certain point, the acquisition of knowledge of facts should be, as at present, tested by examination, but I saw convinced that the system is at present pushed to an extreme, and the state of the state ciently qualified.

It may also be said that undue advantage would be taken by the teacher in recommending unfit students for graduation. Teachers in such positions are, I believe, generally honourable men; they are chosen after the most careful inquiry into their past career It is not held fitting in commercial circles to appoint a clerk or an accountant on good recommendations, and after sufficient apprenticeship, and then to surround him with safeguards, in case he turn out incapable or dishonest

The objection may possibly be raised, that under such a system the standard of degrees would be very uneven, but what of that? As at present, anyone applying for a post of any kind would furnish a reference to his teachers, and a private letter from one well acquainted with the candidate turns the scale, for or against, in spite of every degree in the United

In plain English, degrees, as at present given, are not valued by that portion of the public qualified to judge, and we must face this fact, and endeavour to render a degree a real mark of

I believe, with Mr Dickins, that the examinations of the University of London have done much in disseminating knowtedge, and they have therefore proved of great service, but fedge, and they have therefore proved of great service, but except in the case of the higher degrees before mentioned, and of the degrees in the Faculty of Medicine where evidence of training is a new yell sond. I greatly doubt whether they have contributed towards the creation of knowledge, or training in originality And from the very nature of the constitution of the University of London, it is impossible that it should be otherwise. This of Lobiust, it is impossione that it is notwed by clearure were morning. I happened to ask a student attending my lectures on organic chemistry why he, a B. Sc. in chemistry, was attending my lectures. His reply was characteristic: "I scamped up enough of the subject privately, in; to squeeze through, hu mow I wish to know it." In any right systems, such a proceeding

should be impossible

It is therefore with the hope that the creation of a teaching University for London might tend to remedy such evils, that I University for London might tend to remedy such evils, inat 1, for one, would welcome it. I would urge that the distinguished names mentioned by Mr. Thiselon Dyer are surely guarantees that the London Colleges recently possessed men capable of imparting the highest standard of knowledge, and of stimulating true originality, yet I believe that it is by no means "cutting cheese with a razor" to employ just such men in watching over the development even of junior students; and it is not without advantage to the most able men of science and of letters to be obliged periodically to devote consideration to "elements" to pass in review first principles. It counteracts the tendency towards specialization, which, however valuable, always limits the mental horizon. I will undertake to say that the quality of the most divined tesching in blookgy and physiology in the control of to pass in review first principles. It counteracts the tendency well be shared by assistants, in order that the professor may have time to devote to research, and to superintendence of advanced students, it would be a serious calamity were the influence of such minds to be withdrawn wholly from the juniors

it is precisely by such a federation of Colleges such as University and King's, and of other sufficiently qualified institutions which have the will and the power to join, that specialization may altimately be effected. The fature occupants

of the chairs may be chosen so as to represent every side of a subject; and anyone wishing to pursue research in any special branch would have no difficulty in selecting that particular college where his specialty was also the specialty of the teacher.

WILLIAM RAMSAY

No well wisher of the University can feel otherwise than no well waner of the University can teel otherwise than grateful to you for affording a portion of your valuable space for the letters of Mr Thiselton Dyer and Mr Dickins on this subject. No two men could be found to speak with greater authority from first-hand knowledge of the facts. The arguments on the ject. No two men could be found to speak with greater authority from first-hand knowledge of the facts. The arguments on the subject have been too much of an exparte character hitherto, not setdom based on insufficient mformation or erroneous impressions. Nothing, for example, could be further from the truth than the statement in the *limes* of May 13, by the writer of what was

upon the whole a fair and comprehensive leading article, that 'there is no reason why the highest honours of the University of London should not be obtained by a person who never set foot in London or even in England "Many, who like myself foot in London or even in England "Many, who like myself voted for the projected scheme of the Senate, must have felt, as I did, as a result of a wide and varied educational experience, that it was potential with great good in the future, and could be ac-University, although we felt that the one serious blot in it was the abandonment of uniformity in the examinations for the pass degrees. I verily believe that this was the one thing fatal to its success in Convocation, that it was so far in excess of the recommendations of the Royal Commission as to be unwarrantable, and that it put a lever into the hands of the opposition, of which—as the event proved—a practised disputant like Mr Bompas did not fail to make most effective and disastrous use

Wellington College, Berks, May 25. A. IRVING

Quaternions and the "Ausdehnungslehre"

THE year 1844 is memorable in the annals of mathematics on account of the first appearance on the printed page of Hamilton's "Quaternions" and Grassmann's "Ausdehnungslehre." The "Quaternions" and Grassmann's "Ausdehnungslehre." The former appeared in the July, October, and supplementary numbers of the Philosophical Mayazine, after a previous communication to the Royal Iriah Academy, November 13, 1843 Thus communication was indeed announced to the Council of the Academy four weeks earlier, on the very day of Hamilton's ocaucany rout weeks earner, on the very day of Hamilton's discovery of quaternions, as we learn from one of his letters. The author of the "Auxidehungglehre," although not unoucous of the value of his ideas, seems to have been in no haste to place himself on record, and published nothing until he was able to give the world the most characteristic and fundamental to the contract of the contract o mental part of his system with considerable development in a treatise of more than 300 pages, which appeared in August

iffeating to more time. See the second process of the second proce Historical justice, and the interests of mathematical science, seem to require that the allisions to the "Ausdehnungslehre" in the article on "Quaternions," in the last edition of the "Encyclopædia Britannica," and in the third edition of Frof. Tait's "Treatise on Quaternions," should not be allowed to pass without protest

It is principally as systems of geometrical algebra that qua ternions and the "Ausdehnungslehre" come into comparison "To appreciate the relations of the two systems, I do not see how we can proceed better than if we ask first what they have in common, then what either system possesses which is peculiar to uself. The relative extent and importance of the three fields, itself. The relative extent and importance of the three helds, that which is common to be two systems, and those which are pecalist to each, will determine the relative rank of the geometrical algebras. Questions of priority can only relate to the field common to both, and will be much simplified by having the limits of that field clearly drawn

Geometrical addition in three dimensions is common to the

to systems, and seems to have been discovered independently both by Hamilton and Grassmann, as well as by several other persons about the same time. It is not probable that any especial chiam for priority with respect to this principle will be unged for either of the two with which we are now concerned.

The functions of two vectors which are represented in quaternions by Saß and Vaß are common to both systems as published in 1844, but the quaternion is peculiar to Hamilton's. The linear vector function is common to both systems as allimited yelevoleps, although mentioned only by Grassmann as mately developed, although mentioned only by Grassmann as

early in 1844.

To those stready acquainted with quaternions, the first quanton will naturally be: To what extent are the geometrical method which are unually called quaternione peculiar to be a superior with the properties of t early as 1844. understanding the functions Sad and Vag, but having no occuption of the quaternion ag, or at least could be made so by triffing changes of notation, as by writing S or V in place where they would not affect the value of the expressions. For such a text the examples and illustrations in treatises on quasimeter of the control of places and the control of the control of the control of places and the control of the straight of the control of inc and pane, the sphere and cyclic cone, surfaces of the second degree, geometry of curves and surfaces, hatematics, statics and kinetics of a rigid system, special kinetic problems, geometrical and physical optics, electrodynamics, general expressions for the action between linear elements, application of v to certain

physical analogies, pp 160-371, except the examples (not worked out) at the close of the chapters. worked out) at the crose of the chapters.

Such an examination will show that for the most part the
methods of representing spatial relations used by quaternoone
writers are common to the systems of Hamilton and Grassmann
To an extent comparatively limited, cases will be found in which
the quaternoone idea forms an essential element in the agnifica-

tion of the equations.

გი

into of the equations.

The question will then arise with respect to the comparatively limited field which is the peculiar property of Hamilton, How moportain zer is advantaged to be gained by the use of, the quaternion? This question, unlike the preceding, is one nato which a personal equation will necessaryly setter. Everyone which a personal equation will necessaryly setter. Everyone that it his that it may be safely affirmed that in the municipal of cases in this field the advantage derived from the use of the quaternion is elther doubtful or very infling. There remains a resideam of cases in which a substantial advantage in gained by the use of the quaternionic method. Such cases, however, the proposal of the control of the property of the control of the property of We have now to inquire what we find in the "Ausdehnungs-

lehre" in the way of a geometrical algebra, that is wanting in eare: In the way or a geometrical sigeora, that is wanting in quaterions. In addition to an algebra of vectors, the "Aps-dehnungslehre" afford's a system of geometrical algebra in which the point is the fundamental element, and which for conve-nience I shall call Grassmann's algebra of points. In this algebra we have first the addition of points, or quantities located at points, which may be explained as follows. The equation

$$aA + bB + cC + &c = cE + fF + &c,$$

in which the capitals denote points, and the small letters scalars (or ordinary algebraic quantities), significant that

$$a + b + c + &c. = e + f + &c.,$$

and also that the centre of gravity of the weights a, b, c, &c., at the points λ , B, C, δC , α , is the same as that of the weights ϵ , f, δC , at the points K, F, δC . (will be understood that negative weights are allowed as well as positive.) The quation in thus equivalent to four equations of ordinary algebra. In this Grassmann was anticipated by Mobils ("Barycentrischer Caleul,"

We have next the addition of finite straight lines, or quantities located in straight lines (Liniengrossen). The meaning of the

will perhaps be understood most readily, if we suppose that each member represents a system of forces acting on a rigid body. The equation then sugnifies that the two systems are quaralent. An equation of this form is therefore equivalent to six ordinary equations. It will be observed that the *Littimguston* AB and CD are not simply vectors, they have not merely length and direction, but they are also located each in a merely length and direction, but they are also located each in a given line, although their position within those lines is immaterial In Clifford's terminology, AB is a rotor, AB + CD a motor. In the language of Prof. Ball's "Theory of Screws," AB + CD represents either a twist or a wrench.

MAY 28, 1801

We bave next the addition of plane surfaces (Plangrossen), The equation

signifies that the plane JKL passes through the point common to the planes ABC, DEF, and GHI, and that the projection by parallel lines of the triangle JKL on any plane is equal to the sum of the projections of ABC, DEF, and GHI on the same sum of the projections of ADC, DCT, and OTAL on the same plane, the areas being taken positively or negatively according to the cyclic order of the projected points. This makes the equation equivalent to four ordinary equations

Finally, we have the addition of volumes, as in the equation

where there is nothing peculiar, except that each term repre-sents the six-fold volume of the tetrahedron, and is to be taken positively or negatively according to the relative position of the oints

points
We have also multiplications as follows:—The line (Linear,
prost) AB is regarded as the product of the points An AB.
The Flangroux ABC, which reprivatis the double area of the
the Flangroux ABC, which reprivates the double area of the
and C, or as the product of the line AB and the point C, or of
BC and A, or indeed of BA and C. The volume ABCD, which
represents six times the setrabedron, is regarded as the product of
the points A, B, C, and D, or as the product of the point A, and
the Plangroux BCD, or as the product of the lines AB and
the Regarder and the product of the lines AB and
the Regarder and the product of the lines AB and
the Regarder and the product of the lines AB and
the Regarder and the product of the lines AB and
the Regarder and the product of the lines AB and

This does not exhaust the wealth of multiplicative relation which Grassmann has found on the very elements of geometry. The following products are called regressive, as distinguished from the progressive, which have been described. The product of the Planguisten ABC and DEF interest, which is equal in numerical the planes ABC and DEF interect, which is equal in numerical value to the product of the double areas of the triangles ABC and DEF multiplied by the sine of the angle made by the planes. The product of the Linning oise AB and the Plangrosse CDE is the point of intersection of the line and the group CDE is the point of mersection of the line and the plane with a numerical coefficient representing the product of the length of the line and the double area of the triangle multi-plied by the sine of the angle made by the line and the plane. The product of three Plangroises is consequently the point common to the three planes with a certain numerical coefficient. In plane geometry we have a regressive product of two Limen-gross, which gives the point of intersection of the lines with certain numerical coefficient.

certain numerical coemicent. The fundamental operations relating to the point, line, and plane are thus translated into analysis by multiplications. The immense flexibility and power of such an analysis will be appreciated by anyone who considers what generalized multiplication in connection with additive relations has done in other fields, as in quaternions, or in the theory of matrices, or in the algebra of logic. For a single example, if we multiply the equation

$$AB + CD + &c. = EF + GH + &c.$$

The field in which Grassmann's algebra of points, as distinguished from his algebra of vectors, finds its especial application and utility, is nearly coincident with that in which, when we use the methods of ordinary algebra, tetrahedral or anharmonic or memora or rottniny sugeous, ternateurs or animal moral co-ordinates are more appropriate than rectilinear. In fact, Grassmann's aigebra of points may be regarded as the applica-tion of the methods of multiple algebra to the notions connected with tetrahedral co-ordinates, just as his or Hamilton's algebra of vectors may be regarded as the application of the methods of multiple algebra to the notions connected with rectilinear co-ordinates. These methods, however, carried the field to which they are applied with new notions. The first control of the co co-ordinates, is very much greater than when it takes the pro-of three co-ordinates, for the same reason that a multiple algebra taking the place of three co-ordinates is very much more useful taking the place of three co-ordinates is very much more useful than one taking the place of two. Grassmann's algebra of points will always command the admiration of geometers and analysts, and furnishes an instrument of marvellous power to the er, and in its general form, as applicable to space of any number of dimensions, to the latter. In the physicist an algebra of points is by no means so indispensable an instrument as an

algebra of vectors.

Grassmann's algebra of vectors, which we have described as coincident with a part of Hamilton's system, is not really anything separate from his algebra of points, but constitutes a part of it, the vector arising when one point is subtracted from another. Yet it constitutes a whole, complete in itself, and we may separate it from the larger system to facilitate comparison with the methods of Hamilton.

with the methods of Hamilton. We have, then, as geometrical algebras published in 1844, an algebra of vectors common to Hamilton and Grassmann, augmented on Hamilton's side by the quaternion, and on Grassmann's by his algebra of points. This statement should be mann's by his algebra of points. This statement should be made with the reservation that the addition both of vectors and

made with the reservation that the addition to out or vectors and of points had been given by earlier writers.

In both systems as finally developed we have the linear vector function, the theory of which is identical with that of strains and rotations. In Hamilton's system we have also the linear quaterions function, and in Crassanann's the linear function applied to the quantities of his algebra of points. This function applied to the quantities of his algebra of points. This application gives those transformations in which projective properties are preserved, the doctrine of reciprocal figures or many properties are preserved, the doctrine of reciprocal figures or many properties are properties and properties are the account of the properties and the theory of marrices, but we are here considering only the geometrical side of the theory.)

In this earliest writings on quaternions, Hamilton does not discuss the linear function.

(1853), he treats of the inversion of the linear vector function. (1833), he treats of the inversion of the linear vector function, as also of the linear quaternois function, and shows how to find as also of the linear quaternois function, and shows how to find the state of the case of t to the quaternion function.

In Grassmann, although the linear function is mentioned in the first "Ausdehoungslehre," we do not find so full a dis-cussion of the subject until the second "Ausdehoungslehre" (1862), where he discusses the latent roots and axes, or what corresponds to axes in the general theory, the whole discussion relating to matrices of any order. The more difficult cases are included, as that of a strain in which all the roots are real, but there is only one axis or unchanged direction. On the formal side he shows how a linear function may be represented by a quotient or sum of quotients, and by a sum of products, uckenausdruck.

Luckensustanck.
More important, perhaps, than the question when this or that theorem was find published in the question where we first find theorem was find published in the question where we first find of linear functions, or the algebra of instances, as as it is now generally called fin vol., xxx. p. 35, of this journal, Frod. Martines "as consustings" a second battle of Algebra is exacted as the second transfer of the first perhaps are not as the second transfer of the first perhaps are not as the second transfer of the first perhaps are not as the second transfer of the first perhaps are not as the second transfer of the first perhaps are not as the second transfer of the first perhaps are not as the second transfer of the first perhaps are not as the second transfer of the first perhaps are not as the second transfer of the first perhaps are not as the second transfer of the first perhaps are not as the second transfer of t as a sum of a kind of products (luckenhaltse, or open), is

described in a note at the end of the first " Austlehnungslehre " There we have the matrix given not only as a sum, but as a sum of products, introducing a multiplicative relation entirely different from the ordinary mulisplication of matrices, and hardly less from the ordinary multiplication of matrices, and hardly less fruitful, but not lying nearly so near the surface as the relations to which Prof. Sylvester refers The key to the theory of matrices is certainly given in the first "Ausdehuungslehre," and if we call the birth of matricular analysis the second birth of algebra, we can give no later date to this event than the memorable year of 1844

memorable year of 1844
The immediate occasion of this communication is the following passage in the preface to the third edition of Prof Tail's
"Mammitton not only published his theory complete, the
year before the first (and extremely imperfect) sketch of the
'Austehnungsiehre' appeared, but had given ten years
before, in his provinced study of Sets, the very processes of external and internal multiplication (corresponding to the Vector external and internal multiplication (corresponding to the Vector and Scalar parts of a product of two vectors) which have been put forward as specially the property of Grassmann 'For additional information we are referred to art 'Quaternions,' 'Encyc. Brit.,' where we read respecting the first 'Audehnugliche' ...

"he particular two species of multiplication ('inner' and 'outer') of directed lines in one plane were given. The results outer) of directed lines in one plane were given. The results of these two kinds of multiplication correspond respectively to the numerical and the directed parts of Hamilton's quaternion product. But Grassmann distinctly states in his preface that he also had better to extend his method to angles in space.

had not had lessure to extend nip methou to angues in space.

But his claims, however great they may be, can in no way conflict with those of Hamilton, whose mode of nultiplying couples (in which the 'inner' and 'outer' multiplication are es-entially involved) was produced in 1833, and whose quaternion system was completed and published before Grassmann had es-entailly unrowed) was produced in 1833, and whose quaternous operation was completed and published before Grassmann had elaborated for press even the radimentary portions of his own the production to angle in space, his doct even been stacked." I shall leave the reader to judge of the accuracy of the general terms used in these passages in comparing the first "Audelmungslebre" with Hamilton's system as published in 1843 or 1844. The specific statements respectively. Thinking and Grassmann

The specime statements respecting reasonation and crassmanin require an answer.

It must be Hamilton's "Theory of Conjugate Functions or Algebraic Couples" (read to the Royal Irish Academy 1833 and 1835, and published in vol xvii. of the Transactions), to which reference is made in the statements concerning his "protracted study of Sets" and "mode of multiplying couples". But I cannot find anything like Grassmann's external or internal multiplication in this memoir, which is concerned, as the title pretty clearly indicates, with the theory of the complex quantities of ordinary algebra.

It is difficult to understand the statements respecting the "Ausdehnungslehre," which seem to imply that Grassmann's

two kinds of multiplication were subject to some kind of limitatwo kinds of multiplication were subject to some kind of imita-tion to a plane. The external product is no limited in the first "Ausdehnungslehre" even to three dimensions. The internal, which is a comparatively simple matter, is mentioned in the first "Ausdehnungslehre" only in the preface, where it is defined, and placed beside the external product as relating to directed There is not the least suggestion of any difference in the

products in respect to the generality of their application to vectors.

The misunderstanding seems to have arisen from the following sentence in Grassmann's preface. "And in general, in the consentence in Grassmann's preface "And in general, in the con-sidration of angles in space, difficulties present themselves, for the complete (adistrity) solution, of which I have not yet had sufficient leasure." It is not supprising that Grassmann should have required more time for the development of some parts of this system, when we consider that Hamilton, on his discovery of quaternions, estimated the time which he should wish to devote quatermons, estimated the time which he should with to devote to them at ten or fifteen years (see ha letter to Prof I att in to them at ten or fifteen years (see ha letter to Prof I att in took several years to prepare for the press as many pages as took several years to prepare for the press as many pages as when the profit of the press as many pages as when the profit of the press as the pressure of the press as the pressure of the press as the pressure of t years 1843-44. Such a comparison should be baset on the

Such a comparison I have endeavoured to make, or rather to indicate the bears on which it may be made, so far as systems of indicate the bears of the such as the such as the such as in general, I suppose that there is no question that Grassmann's system is of Indefinitely greater extension, having no limitation to any particular number of dimensions.

I. WILLARD GIBBS.

The Flying to Pieces of a Whirling Ring.

IN NATURE of May 14 (p. 31) I notice a letter by Mr. C. A. Carus-Wilson on the rotation of a hollow steel flask, composed Carus-Wilson on the rotation of a hollow steel Bask, composed apparently of a sphencialshell mounted on an axis constituting a diameter. Mr Carus-Wilson speaks of this body as being under a "tension" of "3" 3" 50 hos per square noth" at a certain speed of rotation. He does not, however, specify what is the tension to which he refers, nor where it is found, earther does he give the density and elastic constants of the material hor indicate the method by which he arrived at his result.

indicate the method by which he arrived at his result. So far as I know, the only problem of the kind which has yet been solved is that of an isotropic spherical shell 1 rotating about an imaginary axis through its centre at speeds at which the strains follow Hooke's law 1 his differs from the case Mr Carra Wilson speaks of, inasmuch as the existence of a real material axis must introduce conditions somewhat different from those assumed by the mathematical theory, and further the results obtained by this theory cannot legitimately be applied to speeds exceeding that where bulging becomes sensible, if indeed so far.

This solution is probably, however, the nearest to the According to it the strains and stresses vary throughout the

According to it the strains and stresses vary throughout the shell with the distance from the centre, and the angular distance from the exist of rotation. They also depend on the density and on the elastic properties of the material. There are also at every point three principal stresses, whereoft one it is true vanishes over the surfaces. Thus such a statement as Mr.

Carus-Wilson's requires further explanation Carus Wilson's requires further explanation
According to the two thores most commonly entertained, the
quantity which determines the limiting safe speed as the manmun value of enter the greatest irrition to the maximum viteradifference—ir. the algebrated difference between the greatest
and least principal artesses at a goant. Over the surfaces of
and least principal artesses at a goant. Over the surfaces of
are found, for shells of all degrees of his/lones, in the equatorial
binan—or poline through the contains personalization to he are plane-or plane through the centre perpendicular to the axis of rotation

Denoting the angular velocity by ω , the radii of the outer and inner surfaces respectively by a and a', the density by ρ , Young's inner surfaces respectively by a and a, the density op ρ_1 , roung a modulus by E, the greatest strain by s, the maximum stress-difference by S, and the stress at right angles to the mendian plane by Φ , the three last quantities beling measured in the equator, the following are some of the results I found for materials in which Poisson's ratio is 1/4 -

			S/wford		20مرابيات	
	Inner	Outer	Inner	Outer	Inner	Outer
	_	-				
d/a = 0'9	0 950	0 833	1 064	n 866	0 912	o 866
negligible	10	10	10	10	10	10

Apparently in the case mentioned by Mr. Caras-Wilson, a/Jan 15/16 = 0 3275. Supposing the material to have Polsono's ratio = 1/4, which seems to accord fairly with experiments on a constraint of the properties of the strains and stresses over the surfaces for a series of values

' Cambridge Philosophical Society's Transactions, vol. xiv pp. 467-483 NO. 1126, VOL. 44]

of a'/a for materials in which Potsson's ratio is 1/4. These give by interpolation fairly accurate values for all values of a'/a. For other values of Poisson's ratio, recourse must be had to the For other values of Poisson's ratto, recourse must be had to the general formule given in the paper, unless $\epsilon_i \equiv 1 - a/a_i$, is very small, when the greatest values of z and S are given approximately by $E_z/a^2\rho g^2 = 1 - \frac{1}{2}e(1-\eta)$, $S/a^2\rho g^2 = 1 + e/(1+\eta)$, where η is Poisson's ratio (see Camh. Trans., vol. xiv. p. 304).

A Comet observed from Sunrise to Noon.

A structure ago the loan of an old number of Harper; Abenduly 1 mag ago the loan of an old number of Harper; Abenduly 1 mag ago the loan of an old number of Harper; Abenduly 1 mag and 1 mag and 1 mag and 1 mag anticle, on the origin of celestial species, by J. Norman Lockyer, F.R.S., Cor. Inst France, that set me thinking of what I behaved of the great comet of 1882, when I made its tremenobserved of the great comet of 1893, when it made its tremen-dous plunge round the sun, on September 18. At that of the sun of the Islands, and on the day mentioned—in latitude 16° 25° S. longitude 151° 57° W of Greenwich, a position about midway between the two islands Bolahola and Maupiti (the Maurias of Cook)—I saw, with the naked eye, the comet travel about 90° of Cook—I saw, with the nazed eye, the comet travel about 90 or the circle of the un's disk, between sunner and noon, but what made it most remarkable to us was that it should be possible for us, in a perfectly clear sky, to be able to watch it all, from sunrise to noon, with very hitle more distress to the eye than if in a clear night looking at a full moon

in a clear high! looking at a tuil moon. Now, Sir, may it not be that this is partly a proof of the theory set furth by Norman Lockyer in the article above mentioned, viz that comets are swarms of meteorites in collision, travelling through space, and that the outer invisible part of the swarm that formed this comer's nucleus had partially eclipsed the sun, like a veil over it? I am not aware if it was noticed by any competent astronomer or not, but the chances are that none had the splendid opportunity that we had to see the none had the splendid opportunity that we had to see the phenomena, so, Sir, knowing that men of science are always glind to get facts from observers in all parts of the world is my glind to get facts from observers in all parts of the world is my address. Thinking this, although latic, may probably be of some interest to the scientific world, I leave you to do what you may think proper with it. think proper with it Rainten, January 30

Graphic Daily Record of the Magnetic Declination or Variation of the Compass at Washington

I seg to call your attention to the enclosed reprint from the I suc to call your attention to the enclosed reprint from the Wy blotc Chart of curves of magnetic declination as recorded that we have been a second of the control of the control of the control of the curves as shown on the Plott Chart, been; in black and white, and only reduced to two fifths of true size (the reduction on the Plot Chart of the control control of the control control of the co longer unless certain decided advantages develop. It may be of sufficient interest to NATURE to republish these curves, and thus sufficient interest to NATORE WILLIAM ASSIST US IN GIVING them wide publicity.

RICHARDSON CLOORE,

Washington, D C , May 6, Hydrographer.

Washington, D. C., May 6.

Hydrographer.
We are unable to print the curves, but we may note that they are issued with the following explanation.—" These curves methods graphically the time direction in which the magnetic methods graphically the time direction in which the magnetic from noon, March 26, to noon, Agril 30. The base-line shows a light break at the end of each two lours, 75th mention time, and the amount of westerly variation at any time is 4* Juliu the number of minutes represented by the legicale at the engine of the magnetic forms of the diagram. The slight breaks in the carve left margin of the diagram. The slight breaks in the carve lief occur when the chronograph sheets are changed. Although the dialy change of wastion at any one place, even in magnetic is too small to be of any importance in practical availation, yet it is though that the promp jublication of these curves cannot fall to linear smarters of vasaels, as well as acclanition men. The many such curves, shows that there is a regular, though slight,

daily change in the variation, somewhat analogous to the daily range of the barometer, although the daily minimum of variation and the state of the tion at sea, and to the general importance of the subject in connection with vessels' compasses and the variation curves plotted on our charts "]

The Alpine Flors.

Inc connection with this subject (see NATURE, vol. xlm. p. 58) it may be well to draw the attention of botansits to the fact that a young vigorous strawberry plant, in an exposed garden, will, during the winter season, place all its leaves in a pericely horizontal position, some even close to and resting on the ground, in utrising contant to its assumer labble of exit with the contract of the same of the strawberry description of the property of the property

Whether direct climatal conduions be the sole cause of this peculiarity, or whether inherited, I cannot determine, presumably, in its natural surroundings, the continual crowding and con-sequent struggle would not necessitate the adoption of dwarfing as a means of survival. May 13.

Magnetic Anomalies in Russia

The magnetic Anomalies in Kussia.

The magnetic desturbances in England and Wise as committee, the committee of the committee

Principal centres of	Decl	Incl	Total force.
disturbance Nepchaevo	+ 48	+ 8°	0.84
Visloe		+ 52	0 65
Kiaselevo	- 33 - 38	+ 63	0 72
Sobinino Petropavlovka	+ 30	+ 60 + 76	0 75 0 80
Belgorod .	- 36	+ 71	0 64

The normal values are - 1° Decl , + 64° Incl.; 0'48 total force. The districts are covered by sedimentary rocks force. The districts are con St. Petersburg, April 30. A. DE TILLO.

THE REJUVENESCENCE OF CRYSTALS.

TERY soon after the invention of the microscope, the value of that instrument in investigating the pheno-

value of that instrument in investigating the pheno-mena of crystallization began to be recognized. The study of crystal-morphology and crystallogenesis was initiated in this country by the observations of Robert Boyle; and since his day a host of investigators-among whom may be especially mentioned Leeuwenhoek and Vogelsang in Holland, Link and Frankenheim in Ger-many, and Pasteur and Senarmont in France—have added many, and Pasteur and senamont in rance—nave anden largely to our knowledge of the origin and development of crystalline structures. Nor can it be said with justice that this field of investigation, opened up by Enghish pioneers, has been ignobly abandoned to others, for the credit of British science, has been fully maintained by the numerous and brilliant discoveries in this department of knowledge by Brewster and Sorby,

There is no branch of science which is more dependent for its progress on a knowledge of the phenomena of for its progress on a knowledge of the phenomena of crystallization than geology. In seeking to explain the complicated phenomena exhibited by the crystalline masses composing the earth's crust, the geologist is

The Friday Evening Discourse, delivered at the Royal Institution on touary 30, 1891, by Prof John W Judd, F R S.

NO. 1126, VOL. 44]

constantly compelled to appeal to the physicist and chemist; from them alone can he hope to obtain the light of experiment and the leading of analogy, whereby he may hope to solve the problems which confront him.

But if geology owes much to the researches of those physicists and chemists who have devoted their studies to the phenomena of crystallization, the debt has been more than repaid through the new light which has been thrown on these questions by the investigation of naturally-formed

crystals by mineralogists and geologists
In no class of physical operations is time such an inportant factor as in crystallization; and Nature, in producing her immittable examples of crystalline bodies, bas been unsparing in her expenditure of time. Hence it is not surprising to find that some of the most wonderful phenomena of crystallization can best be studied—some, indeed, can only be studied—in those exquisite specimens of Nature's handswork which have been slowly claborated by her during periods which must be measured in millions of vears.

I propose to-night to direct your attention to a very curious case in which a strikingly complicated group of phenomena is presented in a crystalline mass; and these phenomena, which have been revealed to the student of natural crystals, are of such a kind that we can scarcely hope to reproduce them in our test-tubes and crucibles

But if we cannot expect to imitate all the effects which have in this case been slowly wrought out in Nature's laboratory, we can, at least, investigate and analyze them; and, in this way, it may be possible to show that phenoand, in this way, it may be possible to show that pheno-mena like those in question must result from the pos-session by crystals of certain definite properties. Each of these properties, we shall see, may be severally illus-trated and experimentally investigated, not only in natural products, but in the artificially-formed crystals of our laboratories.

In order to lead up to the explanation of the curious phenomena exhibited by the rock-mass in question, the first property of crystals to which I have to refer may be enunciated as follows - -

Crystals possess the power of resuming their growth after interruption, and there appears to be no limit to the time after which this resumption of growth may take

It is a familiar observation that if a crystal be taken from a solution and put aside, it will, if restored after a longer or shorter interval to the same or a similar solution, continue to increase as before But geology affords innumerable instances in which this renewal of growth in crystals has taken place after millions of years must have elapsed Still more curious is the fact, of which abundant proof can be given, that a crystal formed by one method may, after a prolonged interval, continue its growth under totally different conditions and by a very different method. I hus, crystals of quartz, which have clearly been formed in a molten magma, and certain inclosures of glass, may continue their growth when brought in contact with solutions of silica at ordinary temperatures. In the same way, crystals of felspar, which have been formed in a mass of incandescent lava, may increase in size, when solvent agents bring to them the necessary materials from an enveloping mass of glass, even after the whole

It is this power of resuming growth after interruption, which leads to the formation of zoned crystals, like the fine specimen of amethyst enclosed in colourless quartz. which was presented to the Royal Institution seventy years ago by Mr Snodgrass.

The growth of crystals, like that of plants and animals,

is determined by their environment; the chief conditions affecting their development being temperature, rate of growth, the supply of materials (which may vary in quality as well as in quantity), and the presence of cortain foreign bodies.

It is a very curious croumstance that the form assumed by a crystal may be completely altered by the presence of minutesimal traces of certain foreign substances, be it remarked, which do not enter in any way into the composition of the crystallizing mass. Thus there are certain crystals which can only be formed in the presence of water, fluorides, or other sails. Such foreign bodies, which exercise an influence on a crystallizing substance without entering into its composition, have because without entering into its composition, have because of the bodies known to chemists as "ferments," so many of which are now proved to be of organic origin of which are now proved to be of organic origin of which are now proved to be of organic origin.

Studied according to their mode of formation, zoned crystals fall naturally into several different classes

In the first place, we have the cases in which the successive shells or zones differ only in colour or some other accidental character. Sometimes such differently coloured shells of the crystal are sharply cut off from one another, while in other instances they graduate imperceptibly one into the other.

can be seen that the control of the

Some very interesting varieties of minerals, like the Cotterite of Ireland, the red quartz of Cumberland, and the spotted amethyst of Lake Superior, can be shown to owe their peculiarities to thin bands of foreign matter sonally included in them during their growth

A currous class of soned crystals arises when there is a change in the habit of a crystal during its growth. Thus, as Lavalle showed in 1851 (Bull Gol Soc Parts, 2me set, vol viu. pp. 610-13), if an octahedron of alum be substance, and then a quantity of alkaline carbonste be added to the liquid, the octahedral crystal, without change in the length of its axes, will be gradually transfermed into a cube In the same way, a scalenohedron of calcite may be found inclosed in a prismatic crystal of the same in both crystals in of the vertical axis being the same in both crystals in the crystals in the crystals in the crystals in the crystal crystal crystals in the crystal crystal crystal crystals in the crystals in the crystal crystal crystal crystal crystals in the crystal crystal

By far the most numerous and important class of soned crystals is that which includes the forms where the successive sones are of different, though analogous, chemical composition. In the case of the alums and garnets, we may have various stomorphous compounds forming the successive zones in the same crystall; while, in substances crystallizing in other systems than the cubic, we flat compounds forming the different enclosing shells.

audits, and the cases are illustrated by many artificial crystals, and by the tourmalines, the epidotes, and the felspass among minerals. The zones, consisting of different materials, are sometimes separated by well-marked planes; but in other cases they shade imperceptibly into one another

In connection with this subject it may be well to point out that zoned crystals may be formed of two substances

which do not crystallize in the same system. Thus, crystals of the monoclinic augite may be found surrounded by a zone of the rhombic enstatute; and crystals of a trichnic felspar may be found enlarged by a monoclinic

heispan. Still more curious is the fact that, where there is a similarity in crystalline form and an approximation in the dominant angles (plesomorphism), we may have soming and intergrowth in the crystals of substances. Senarmont showed in 18f6, a cleavage-thomb of the natural calicic carbonate (calcite), when placed in a solution of the sodic intrate, becomes enveloped in a sone of this latter substance, and Tichermak has proved the agreeous one if tested by its cleavage, by its susceptibility to twin lamellation, or by the figures produced by ething In the same way, arrons, which are composed of the two oxides of silicon and airconium, are found grown in composite crystals with xenotime, a phosphate

of the metals of the cerium and strium groups. These facts, and many similar ones which might be addited, point to the conclusion that the beautiful theory of isomorphism, as originally propounded by Mitscherick, stands in need of much revision as to many important details, if not, indeed, of complete reconstruction, in the light of modern observation and experiment

The second property of crystals to which I must direct your attention is the following -

If a crystal be broken, or mutilated in any way whatever, it possesses the power of repairing its injuries during subsequent growth.

As long ago as 186, Frankenhem showed that, if a drop of a started solution be allowed to evaporate on the stage of a microscope, the following interesting observations may be made upon the growing crystals. When they are broken up by a rod, each fragment tends to re-form as a perfect crystal, and if the crystals be caused to be partially re-dissolved by the addition of a minute drop of the mother liquor, further evaporation causes them to resume their original development (Pogg. Alm., Bd xxxv., 1856)

In 1842, Hermann Jordan showed that crystals taken from a solution and mutilated gradually became repared or healed when replaced in the solution (Multer Archiv. fur 1842, pp. 46-56) Jordan's observations, which were published in a medical journal, do not, however, seem to have attracted much attention from the physicists and chemists of the day.

Lavalle, between the years 1850 and 1853, and Kopp, in the year 1855, made a number of valuable observations bearing on this interesting property of crystals (Letony Am, curv., 1855, pp. 118-25). In 1856 the subject was more thoughly suddle by times investigators who puber of the property of the subject was marked to the property of the property of

As long ago as 1851, Lavalle had asserted that, when one solid angle of an octahedron of alum is removed, the crystal tends to reproduce the same mutilation on the opposite angle, when its growth is resumed! This remarkable and anomalous result has, however, by some subsequent writers been explained in another way to that suggested by the author of the experiment.

In the same way the curious experiments performed at a subsequent date by Karl von Hauer, experiments which led him to conclude that hemihedrism and other pecu-

* Bull Geel Set Parts, ame ser, vol van pp 610-13, 1851, Mosgao, (eamet, 11, 1853, pp 454-56, (empt rend , xxxvi , 1853, pp, 403-05

liarities in crystal growth might be induced by mutilation.1 have been asserted by other physicists and chemists not to justify the starting conclusions drawn from them at the time. It must be admitted that new experiments bearing on this interesting question are, at the present time greatly needed.

In 1881, Loir demonstrated two very important facts with regard to growing crystals of alum (Compt rend, Bd. xcii. p 1166) First, that if the injuries in such a crystal be not too deep, it does not resume growth over its general surface until those injuries have been repaired Secondly, that the injured surfaces of crystals grow more rapidly than natural faces. This was proved by placing artificially-cut octahedra and natural crystals of the same

size in a solution, and comparing their weight after a certain time had elansed.

The important results of this capacity of crystals for undergoing healing and enlargement, and their application to the explanation of interesting geological phenotion to the explanation of interesting geological phenomena has been pointed out by many authors. Sorby has shown that, in the so-called crystalline sand-grains, we have broken and worn crystals of quarte, which, after many vicissitudes and the lapse of millions of years, have grown again and been enveloped in a newly formed quartz-crystal. Bonney has shown how the same phenomena are exhibited in the case of mica, Berke and Whitman Cross in the case of hornblende, and Merrill in the case of augite In the felspars of certain rocks it has been proved that crystals that have been rounded, cracked, corroded, and internally altered-which have, in short, suffered both mechanical and chemical injuries -be repaired and enlarged with material that differs considerably in chemical composition from the original crystal

It is impossible to avoid a comparison between these phenomena of the inorganic world and those so familiar to the biologist lt is only in the lowest forms of animal life that we find an unlimited power of repairing injuries in the Rhizopods and some other groups a small fragment may grow into a perfect organism. In plants the same phenomenon is exhibited much more commonly, and in orms belonging to groups high up in the vegetable series. Thus, parts of a plant, such as buds, bulbs, slips, and grafts, may -sometimes after a long interval-be made to grow up into new and perfect individuals. But in the mineral kingdom we find the same principle carried to a much farther extent. We know, in fact, no limit to the minuteness of fragments which may, under favourable conditions, grow into perfect crystals—no bounds as to the time during which the crystalline growth may be suspended in the case of any particular individual.

The next property of crystals which I must illustrate, in order to explain the particular case to which I am calling

order to expan the particular case to which I am sample your attention to night, is the following: Two crystals of totally different substances may be developed within the space bounded by certain planes, becoming almost insertricably intergrown, though each retains its distinct individuality.

This property is a consequence of the fact that the substance of a crystal is not necessarily continuous within the space inclosed by its bounding planes Crystals often exhibit cavities filled with air and other foreign substances In the calcite crystals found in the Fontainebleau sandstone, less than 40 per cent. of their mass consists of calcic carbonate, while more than 60 per cent is made up of grains of quartz-sand, caught up during crystalliza-

Wien Sitz. Rev. xxxis., 1860, pp 6:11-22. Erdmann. Journ Practs.
Chem. Ixxxi pp 19:6-6; i Pren Guel Verhandt, xxx pp 2:10-13. Sc.,
Frunkesheld, 1924 das, cxii., 16:50. Compare Ft Schaff, Preg. das.
CXX, 1809, pp 2:50-38. Neur Jakeb Fir Min. &c. 18/50, p 24, and W
3aber. Letter face. cxxxiv. 16:10, pp 3:4-3. also W. Drudid, "Lebrudaw.
Letter face. cxxxiv. 16:10, pp 3:4-3. also W. Drudid, "Lebrudaw.
Propuls., 1888, 164. 1, p 3:14.

In the rock called "graphic granite," we have the minerals orthoclase and quartz intergrown in such a way that the more or less isolated parts of each can be shown, by their optical characters, to be parts of great mutually interpenetrant crystals Similar relations are shown in the so-called micro-graphic or micro-pegmatitic intergrowths of the same minerals which are so beautifully exhibited in the rock under our consideration this evening

There is still another property of crystals that must be kept in mind, if we would explain the phenomena

exhibited by this interesting rock

A crystal may undergo the most profound internal changes, and these may lead to great modifications of the optical and other physical properties of the mineral, yet, so long as a small-often a very small-proportion of its molecules remain intact, the crystal may retain, not only its outward form, but its capacity for growing and

repairing injuries
Crystals, like ourselves, grow old Not only do they suffer from external injuries, mechanical fractures, and chemical corrosion, but from actions which affect the whole of their internal structure Under the influence of the great pressures in the earth's crust, the minerals of deep-scated rocks are completely perineated by fluids which chemically react upon them. In this way, negative crystals are formed in their substance (similar to the beautiful "ice-flowers" which are formed when a block of ice is traversed by a beam from the sun or an electric lamp), and these become filled with secondary products As the result of this action, minerals, once perfectly clear and translucent, have acquired cloudy, opalescent, indescent, avanturine, and "schiller" characters, and minerals, thus modified, abound in the rocks that have at any period of their history been deep-seated. As the destruction of their internal structure goes on, the crystals gradually lose more and more of their distinctive optical and their physical properties, retaining, however, their external form, till at last, when the last of the original molecules is transformed or replaced by others, they pass into those mineral corpses known to us as "pseudo morphs."

But while crystals resemble ourselves in "growing old," and, at last, undergoing dissolution, they exhibit the remarkable power of growing young again, which we, alas i never do fhis is in consequence of the following remarkable attribute of crystalline structures

It does not matter how far internal change and dis-integration may have gone on in a crystal—if only a certain small proportion of the unaltered molecules re-main, the crystal may renew its youth and resume its growth

When old and much-altered crystals begin to grow again, the newly-formed material exhibits none of thus marks of "senity" to which I have referred The sand-grains that have been battered and worn into microscopic pebbles, and have been rendered cloudy by the develop-ment of millions of secondary fluid cavities, may have clear and fresh quartz deposited upon them to form crystals with exquisitely perfect faces and angles The white, clouded, and altered felspar-crystals may be enveloped by a zone of clear and transparent material, which has been added millions of years after the first formation and the subsequent alteration of the original crystal

We are now in a position to explain the particular case which I have thought of sufficient interest to claim your attention to-night.

In the Island of Mull, in the Inner Hebrides, there exist masses of granite of Tertiary age, which are of very great interest to the geologist and mineralogist. In many places this granite exhibits beautiful illustrations of the curious intergrowths of quartz and felspar, of which I have

NO. 1126, VOL. 44]

already spoken. Such parts of the rock often abound with cavities (druses), which I believe are not or original but of secondary origin. At all events, it can be shown that these cavities have been localities in which crystal growth has gone on—they constitute indeed veritable laboratories of withetic nursealogy.

Now, in such cavities the interpenetrant crystals of quarts and felapar in this rock have found a space where they may grow and complete their outward form; and its curous to see how sometimes the quarts has prevailed over the felapar and a pure quart-crystal has been resulted, and up the at other times the opposite effect has resulted, and up the part and the control of the part and the

Those relations can be fully made out when thin sections of the rock are examined under the microscope by the aid of polarized light, and they speak eloquently of the possession by the crystals of all those curious peculiarities of which I have reminded you this evening

By problems such as those which we have endeavoured to solve to-night, the geologist is beset at every step. The crust of our globe is built up of crystals and crystal fragments—of crystals in every stage of development, of growth, and of variation—of crystals undergoing change, decay, and dissolution. Hence the study of the natural history of crystals must always constitute one of the main foundations of geological senior, and the future progress constitution of the control of the

BRITISH INSTITUTE OF PREVENTIVE MEDICINE.

A VIGOROUS attempt is being made by ignorant and prejudiced persons to prevent the establishment of a National Hygenic Institute worthy of the United Kingdom. A deputation will wait upon Sir Michael Hicks-Beach, President of the Board of Trade, on Friday, june 5, to submit to him an exact statement of the facts relating to the matter. Meanwhile, the Executive Committee has susued the following circular.—

On Monday afternoon, July 1, 1880, a meeting was held at the Mansion House, under the Presidency of Strategy of the Monday of the Presidency of Strategy of the Monday of the Land of the Presidency of Strategy of London, 'for the purpose of hearing statements from Str James Paget, and other representatives of scientific and medical opinion, with regard to the recent increase of rables in this country, and the efficacy of the treatment discovered by M Pasteur for the prevention of hydrophobics.

Although convinced of the advantages likely to accrue to the community at large by the founding of a Bactier of the community at large by the founding of a Bactier of the community at large by the founding of a Bactier of the large state of

Acting on the advice of their solicitors, Messrs. Hunters and Haynes, the Executive Committee decided to incorporate the Institute as a limited liability company, with the omission of the word "Limited," in order to impress

the public with the fact that the Institute was not established for purposes of gain, but for purely charitable and scientific objects.

The application was lodged at the Board of Trade on February 13, 1891, and, shortly afterwards, a number of petitions were sent in asking the Board of Trade to withhold its license, as the objects of the Institute "clearly pointed to experiments on living animals." As Chairman of the Committee, Sir Joseph Lister then wrote to the President of the Board of Trade, showing why, in the opinion of the Committee, their opponents should not gain their point. In the first place, he pointed out that the granting of a vivisection license is not within the province of the Board of Trade, but under the control of the Secretary of State for the Home Department In the second place, he clearly proved that it is absolutely necessary that the Institute should be licensed in the manner described, for it could not be registered under the Companies Act, 1862, without most seriously inter-fering with its prospects. From counsel's opinion it is evident that, should the Institute be registered as an ordinary limited hability company under the Act, it would at any time be possible for the members to wind up the company and divide the funds of the Institute; whereas the Board of Trade, in granting the license asked for, would make it a condition that all the property of the Institute should be applied to the advancement of science and kindred subjects only, and not be distributed among the members. In this way only could security be given that the funds would be applied for the purposes intended

This letter was posted by one of the secretaries on May 12, 1861; but on the same day the solicitors to the Executive Committee received a letter from the President of the Board of Trade, who, without giving any reason whatever for his decision, declined to grant the application. On the next day, however, Sir Joseph Lister received a letter in answer to that posted on May 12, in which the President of the Board of Trade numsted his

willingness to receive a deputation on June 5 at 11 a.m. Workers in bacternological scenee are now labouring under considerable difficulties, as there is no place in the United Kingdom specially fitted for such research. By the establishing of this Institute, they would be placed in the best possible conditions for carrying out original investigations. Moreover, a central Institute for the systematic teaching of bacteriology would be provided, not only for medical men, but also for veterinary surgeons, chemists, agriculturists, &c.

At present, in apte of the efforts made in this direction by several methical schools, most of the English workers who with to gain special knowledge in bacterology, are compelled to go to the Continental laboratories for their instruction. The question, therefore, which the Board Trade will have to decide it, whether such a state of things should continue, or whether England should have to will be continued to the state of things should continue, or whether England should have to will be continued to the sound the state of the stat

NOTES.

We are informed that Kew has recently acquired by purchase from Mr. F. Cuttis, a descendant of William Cutts, the founder of the Botanical Magazini, about 1650 original drawings, theirly of figures which appeared in this publication. They belong partly to the first series and partly to the second, from 1800 to 1826—that is only, during the period that the magazine was edited by Dr. Sina. Many of these drawings are very beautiful, and very carefully coloured, appealuly those done by James

Sowerby and Sydenham Edwards; but some of the finest of their work was not reproduced in the plates. The collection also includes some of the poorest work that ever appeared in the magazine. In 1815 Sydenham Edwards seceded, and worked for the rival Botanical Register; Sowerby had ceased contributing, and there seems to have been a lack of novelties for illustration. Towards the end of Dr Sims's editorship, in 1826, the Botanical Magazine was doubtless supplanted in a great measure by the Balanical Register then conducted by the vigorous Lindley. Its circulation greatly decreased, and the impression was small : hence this series is very rare. The following year, however, Sir William Hooker became editor and speedily raised both the artistic and botanical character of the magazine Many of the plates published during the latter half of Dr Sims's editorship are not signed, but all the drawings are, and we learn that William Hooker, the artist of the Paradicus Londonensis. was an occasional contributor. The collection also contains a number of unpublished drawings.

THE Council of the Institution of Naval Architects has resolved to award the gold medal of the Institution to Prof V. B. Lewes for his paper on boiler deposits, read at the Institution's recent annual general meeting.

The President of the Royal Society, who is Chairman of the Board of Visitors, will hold the annual visitation of the Royal Observatory at Greenwich on Saturday, June 6 next. The Observatory will be open for inspection at 3 pm.

MR. JAMES E KEELER, the Astronomer of the Lick Observatory, has lately been appointed Director of the Alleghany Observatory, in succession to Mr S. P Langley, Secretary of the Smithsonian Institution

A CZECH Academy of Sciences was opened at Prague on the 18th inst, by the Archduke Charles Louis The Lain title of the Academy is Bohemica Scientiarum, literarum et artum Academa Imperatoris Frantisci Josephi, the President is Josef Hildrick, and the General Secretary Dr. F J Studmicks.

An extra evening meeting of the Royal Institution will be held on Tuesday, June 2, at nine o'clock, when Dr. Charles Waldstein will give a discourse on the discovery of "The Tomb of Aristotle."

ANMIANN papers announce the death of Prof. J. F. Illigard, late superintendent of the U.S. Coast Surrey. It is want on at Zwebrucken in 1828, went to America with his dahron at Zwebrucken in 1828, went to America with his dahron 1838, and enterted the serves of the U.S. Coast Surrey in 1829. "His work," says the New York. Nation, "thy directly in the cof his profession, in the improvement of methods, the determination of weights and unsasures, and the novel method of accertainty the differences of longitude by telegraph. His publications on those subjects are to be found chiefly in the Coast Surrey Reports. One of the most noteworkly relates to

NO. 1126, VOL. 447

the telegraphic determination of the differences of longitude between Greenwich, Pars, and Washington. He was delegue to the International Meric Commission in 1872, and a member of the International Bureau of Weights and Messares, of which he decilined the directorabilip. He was an original member of the National Audemy of Sciences, and for some years list Home Secretary. In 1874 be was elected President of the American Association for the Advancement of Science. His neceeded to the work of Baches in connection with the work of the Bareau of Weights and Messares, and took a leading part in preparing exact metric standards for distribution to the States and Territoriese.

THE recent botamical mission of Mr. D. Morris to the West Indies forms the subject of the Kew Bulletin for May and June, The Bullutin publishes the official correspondence recording the circumstances under which the Imperial Government assented to Mr. Morru's mission, and reproduces his report to the Secretary of State for the Colonies

THE Kee Bulletin does good servee by publishing lists of parten glasts annually decribed in bostness and abortenitural publications, both boglish and foreign. In Appendix II., 1807, there is a list which compares all the new introductions recorded during 1800. "These lists," says the Bulletin, "are independent between the commentation of correct connectiative, especially in the smaller botanical establishments in correspondence with Kew, which are, as a rule, only scannily provided with bortecultural periodicals. Such a list will also afford information respecting one plants under estilustation at this establishment, many of which will be distributed from it in the regular course of exchange with other botanic garders."

On the 13th inst. the Council of the county borough of Boole deceded to appropriate and set aude for the purpose of technical education the whole of the portion of the Exchaquer contribution account which mays to be used under the provision of the Local Taxatlon (Dustoms and Excue) Act, 1850 The Free Lihray and Museum Committee were centrated with the carrying out of a scheme submitted by them to the Council, Contribution of the Council Counc

life following is an extract from the Times of last week which may interest many of our readers -Some months ago a company, which had been formed at Wheeling, West Virginia, for the purpose of "developing" that city, began to drill a well in search of petroleum or natural gas. A depth of over 4100 feet was reached, and in this distance a dozen thick veins of coal are said to have been passed, while petroleum and gas have both been struck-though not in paying quantities-and gold quartz, iron ore, and many other minerals have been brought to the surface. The officers of the Geological Survey at Washington, according to a Wheeling despatch, have become very interested in the proceeding, and "the hole will be drilled to a depth of one mile " After this the Government will take up the work under the direction of two expert officers of the Survey, and the drilling will be continued into the earth as far as human skill can penetrate. The object is to ascertain the thermometric and magnetic conditions as far as possible

This Transandine Railway across the Andes, connecting the Argentine railway system with that of Chil, has been the subject of an interesting article in Engineering. Our contemporary in its issue of this week again deals with this fine piece of engineering, and describes the tunnelling plant used, as well as the dutribution by electrical means of the power available and uncessary for driving the air compressors for the Ferroux rock

drills used. This line across the Andes consists of a series of tunnels and other heavy works; the tunnels had to be bored in most inaccessible regions, where the means of transport are measure in the extreme. The whole of the plant therefore had to be designed with great care and with special reference to the unusual requirements. Weight had to be minimized, and strength and simplicity had to be carefully obtained. Waterpower was available at some distance from the scene of operations : the water-power was brought to the primary stations by means of 20-inch steel pipes. On the Chilian side the primary station contained ten dynamos and two spare ones, each being of 80 horse-power, and each coupled direct to, and driven by, a Girard turbine. The electric power generated is transmitted through a cable to secondary stations, where, by means of motors, the air-compressors are operated A similar arrangement is in use on the Argentine side, only the dynamos are of 40 horse-power, because they had to be transported over mountains on mules' backs, which made it necessary to minimize the weight. This use of the electrical transmission of power in highly interesting, the circumstances being such that, without it, the boring of the tunnels would have been a work of great expense and magnitude.

Globar has received information from Japan to the effect that there is an increasing reaction in the country against forelign influences. This is said to be especially visible in schools where European instruction is given. The such schools, one of which formerly had 300 pupils, the other 150, have been obliged to combine their forces, having no more than 150 pupils between them. At the University of Tokio the number of native lecturers increases, while that of the foremer wall discresses.

In the New York Sun, Mr G F Kunz, the well-known expert in gems, has recently called attention to a property of the diamond which may serve as a means of distinguishing it from other substances. Referring to the paper of Robert Boyle "On a Remarkable Diamond that Shines in the Dark," oublished in the Transactions of the Royal Society in 1663, Mr. Kunz remarks that this paper has been indirectly alluded to by a number of authors, but never read. Among a quantity of facts Boyle mentions one diamond that phosphoresced simply by the heat of the hand, absorbed light by being held near a candle, and emitted light on being rubbed. He stated that many diamonds emitted light by being rubbed in the dark. The experiments made by Mr. Kunz show conclusively not only that Boyle's statement that some dismonds phosphoresce in the dark after exposure to the sunlight or an arc of electric light is true, but also that all diamonds emit light by rubbing them on wood, cloth, or metal, a property which will probably prove of great value in distinguishing between the diamond and other hard stones, as well as paste, none of which exhibit this phenomenon, and will be welcomed by the general public who do not possess the experience of the dealer in diamonds. The property is evidently not electric, or it would not be visible on being rubbed on me al

We learn from the American Misterological Journal for Applith the appropriation for the new Weather Service of the United States in 579,753 dollars, being an increase of 629,790 dollars on the amount for the current year. This is accounted for by the addition of 50,000 dollars for the proposed extension of the service in agricultural regions, and by the fact that, inder the present arrangement, five of the leading officials were sugged from the army, and their states must theseforward sugged to the army, and their states must theseforward area. The Child of the Service is to receive 4500 dollars a year. No appointment has yet been made to this position. It is quite possible that the present Chief Signal, Officer will be cleasized from the army for this day, and Prof Abbe, Prof. W.

M Davis, Prof. Nipher, and Dr. Hunrich are some of the other propilents meterorlogists mentioned as possible candidates. The same fournal also reports that Dr. Baker, Secretary of the Michaga State Board of Health, has investigated the cause of influena. He stated that the germs are at all times present, but that there must be certain connodent meteorological conditions to irritate the threat and air passages afficiently to let the germ gain an entrance to the body. These softiments of the property of the state of the property of north and north-east words, and the excessive amount of orose demng the past three months.

MR. C. L. WRAGGE has issued a circular, dated February 3 last, stating that "in consequence of the rapid extension of the Meteorological Service of Australasia in connection with the Oueensland Government-an extension which now embraces a large portion of the Western Pacific Ocean, New Guines, and the Malay Archipelago-it has been determined to stop the issue of the large charts which have hitherto dealt with the meteorology of Australasia only, and to issue, instead, in the early future, a weather chart as complete as possible, embracing not only Australasia, but also the regions above indicated," Some charts have already been issued giving the isobaric lines for the region referred to, and extending southwards and eastwards to New Zealand and the New Hebrides. Isobars drawn for 20° to 30° to the eastward of Brisbane must be to a great extent problematical, and in fact this is admitted by the broken lines extending over the ocean The information, to say the least, seems at present insufficient for the purpose, and over large tracts it is absolutely wanting ; but the establishment of stations in remote islands is, of itself, very desirable.

THE other day Prof Vambery delivered in Edinburgh, under the auspices of the Royal Scottish Geographical Society, an interesting lecture on British civilization and influence in Asla. He had many pleasant things to say about England, but did not quite overlook her shortcomings. He said he was immensely struck by the indifference shown by the public at large to everything that concerned Asia. He had lectured in more than 20 towns in this country, and found, even amongst the middle classes, great ignorance in regard to Asiatic geography and ethnography. Assatic languages, moreover, were greatly neg lected. Germany, which had not got any territory in Asia, bestowed far greater attention upon the old world than this country. He opined that if the interest in Asia would increase in this country commensurately with its political power and influence over the various races in Asia. Britain would decidedly remain there a permanent Power which could never be ousted by any rival He thought that there ought to be more schools for Oriental languages in this country. There was a general supposition that Britons in general could not learn foreign languages, but that was not true. The greatest linguists of our age had been British, as, for example, Lord Strangford for Turkish, and the late Sir Richard Burton and the late Prof. Palmer for Arabic Then there were scholars like Sir James Redhouse, Sir Henry Rawlinson, Sir William White, and many others bearing evidence of the brilliant linguistic capacity of the British He believed that nothing could be easier than to recruit in this island a goodly number of Oriental linguists for employment in various Asiatic countries.

A PAPER by Mesan. G. F. Harrs and H. W. Burrows, on the Econes and Oligocene beds of the Paris Bain, is to be assued as a separate publication by the Geologust' Amonation. It will be illustrated by a map and sections. The paper is the result of several years' careful study of the Parisan Tertianes, and close communication with many eminent French geologists. The suthorn give an elaborate appendix, consisting of a list of the fostial Mollucia, some 3500 species, showing the range in

ume; the nomenciature of each species has been critically revised and brought up to date. Careful attention has also been paid to the relationship between recent and Territary forms. The generic names under which most of the shells are still known in this country are added as an assistance to the student.

Tits Physical Society of London has published the first part of the elements housen of its Proceedings. Among the contents are notes on photographs of rapidly moving objects, and on the culcilating electric part, by Mr. C V. Boys, a formula for calculating approximately the self-induction of a cod, by Prof. John Perry, a lecture experiment illustrating the effect of heat upon the magnetic susceptibility of meka, by Mr. Shelford Perry and Components of the Code of the Co

A I ECTURE by Prof. A. Macalister, delivered on January 29, on the opening of the new anatomical lecture-room at Cambridge, has been published by the Cambridge University Press The subject is "The History of the Study of Anatomy in Cam-

MESSES. CHARLES GRIFFID AND CO. have published the eighth annual issue of the "Year-book of the Scientific and Learned Societies of Crest Birnain and Ireland." The work is compiled from official sources, and comprises lists of the papers read dung 1890 before Societies engaged in fourteen departments of research, with the name of their subtract.

THE Engineering Company, publishers, New York, are issuing a new monthly magazine, entitled Engineering, which is to be wholly devoted to the record of industrial progress. The first two numbers have been published

TREER are some valuable morphological notes in the Johns Hopdins University Circulars for May Among other papers we may mention one on the structure and development of the gonophores of a certain Spishonophore belonging to the order Auronestic (Haeckell), by W. K. Brooks and E. G. Conklin. Other papers are, preliminary notes on some new species of Squills, by R. P. Bigelow, and a preliminary note on the nationary and transfer mation of Torantis. by T. H. Moreyn.

Tute "Bibliothèque Évolutioniste" is the general tuile of a new sciennific series which is being published in Paris. The editor is M. Henry de Vangny. The first volumes are mostly translations, Wallace's "Darwinsma" opening the list, but French authors are also to continue, and works are being prepared by Mearis. A. Sabatier, of Montpellier; J. Deniker, the well-known authoropologist, Prof. Girard, and other

IN NATURE for Ma) 14, p. 36, line 5 from top, or "1887" read "1880."

A NEW and very boundful silver mineral a described by Mr. A. Genth in the May number of the American fournal of Science. It was discovered by Schor Aguilar, of the San Carlos Stave Mines at Gausanjanto, Mexico, and has been named after him, aguilatite. It is a sulpho-selenide of silver, of the composition Agg3+ Agg5, the analyses of pure crystals agreeing exactly with this formula. The crystals are into-black in colour, and possess a most brilliant luster. They belong to the cubic system, and consist of carloss shelten dedecahedrons, the edges of which are perfore, while the centre of the faces are frequently elongated its such a manner trace demonstration of the composition of the compos

cakine, which may readily be removed from them by means of dilute active and, frequently a little quarts as associated with them. The crystals are readily sectile and malleable, and their handness is only a 5. Their specific gravity is 7.956. When heated in an open tube to low redness, gradually increasing to heated in an open tube to low redness, gradually increasing to heated may obe the silver, together with a slight insulation of selemina, and stender needles of selemina subhanace of the silver, and stender needles of selemina subhanace of the silver, and stender needles of selemina subhanace of the silver, and stender needles of selemina subhanace of the silver, and stender needles of selemina subhanace of the silver, and stender needles of selemina which has the former subhanace of the silver, and the silver subhanace of the silver, and the silver subhanace of the silver subh

SEVERAL of the simpler sulphides of the organic radicles have been found to occur naturally in the crude petroleum oil of Ohio by Messrs. Mabery and Smith, who describe the mode adopted for their isolation in the current number of the American Chemical Journal As far as they are aware, these alkyl sulphides have never previously been found in nature. When the higher boiling fractions of the distilled oil are agitated with oil of witrad, these sulphur compounds are taken up by the sulphuric acid, and, upon subsequently neutralizing the acid solution with slaked lime, unstable calcium salts are obtained. which are readily decomposed by distillation in steam, which carries over the sulphides without decomposition. By employing these reactions upon a large scale, and afterwards subjecting the mixed sulphides to a rigorous fractional distillation under reduced pressure (150 mm, being the most convenient working pressure), the following sulphides have been isolated, methyl sulphide, (CHa),S; ethyl sulphide, (C,Ha),S, normal propyl sulphide, (C.H.) S; normal and iso-butyl sulphides, (C.H.) S. amyl sulphide, (Caller) S, hexyl sulphide, (Caller), S, and a few other sulphides of mixed radicles Most of these sulphides were obtained in the pure state by treating the products of the fractionation with mercuric chloride, and thus obtaining crystals of the addition compounds of the type (CHa) S HgCl, and subsequently decomposing these crystals of the mercury compounds with sulphuretted hydrogen.

THE additions to the Zoological Society's Gardens during the past week include a Barbary Ape (Macacus innus 6) from North Africa, presented by the Rev. G H Watkins . a Diuca Finch (Disca grisca), two Gay's Finches (Phrygilus gays) from Chili, two De Filippi's Meadow Starlings (Sturnella defilippi) from La Plata, presented by Mr. Charles G Sharpe, two Bankiva Junele Fowls (Gallus bankrea & 9) from India, presented by Captain George James, a Common Rhea (Rhea americana) from South America, presented by Mr R. P. Houston; an Algerian Tortoise (Testudo mauritamea) from North Africa. presented by Mrs Margaret Clarke, a Black eared Marmoset (Hapale pensestlata) from South-east Brazil, presented by Mr. Aubrey Lace, a Capybara (Hydrocherus capybara), a Brown Milvago (Milvago chimango), a Violaceous Night Heron (Nycticorax violaceus) from South America, two Blue bearded Jays (Cyanocorax cyanofogon) from Para, four Crested Screamers (Chauna chavaria) from Buenos Ayres, deposited, two Variegated Sheldrakes (Tadorna varieguta) from New Zealand, two Larger Tree Ducks (Dendrocyena major) from India, purchased, two Japanese Deer (Cerous sila & ?), a Chinchilla (Chinchilla langera), an African Wild Ass (Equus taniopus), born in the Gordens.

OUR ASTRONOMICAL COLUMN.

THE DRAPER CATALOGUE OF STELLAR SPECTRA.—Vol axvii of the Annals of the Astronomical Observatory of Harband Callege contains a catalogue of the spectra of ro, 351 stars, nearly all of them north of the parallel of declination — 25, photographed with the 8 inch Bache telescope. As the work forms a part of the Henry Draper Memorial, it is suggested that it be designated as the Draper Catalogue. In order to produce the spectra, a prints Suckes square and having a refracting angle of 37 was fasteded in front late to the carrier and the state of 37 was fasteded in front late to the carrier and the state of 37 was fasteded in front late to the carrier and the state of 37 was fasteded in front late to the carrier and the state of 37 was fasted in the carrier and the state of 38 was fasted by the letter A to Q. Of these, A, B, C, and D indicate to the carrier and the state of 38 was fasted in the state of 38 was fasted in the state of 38 was fasted in the letter P is reserved for planetary nobular. The clause O and P clouely resemble each other, and are regarded by Prof. and the clause of and present and the state of 38 was fasted by the state Quit state of 38 was fasted by the state of 38 was which may improve our knowledge of stellar constitution

90

SOLAR OBSERVATIONS FROM JANUARY TO MARCH 1891.— In Comptes rendus, No. 19 (May 11, 1891), Prof. Tacchini gives the following account of solar activity during the first three

months of this year. Observations of spots and faculæ have been made on 64 days, viz. 16 in January, 26 in February, and 22 in March The

results obt	ained are i					
	Relative frequency		Relative magnitude			Number
1891	of Spots	of days	of apote	of facular.		groups per day.
January February	. 1.56 . 2.3t	0 30 O 15	18″50 24'04 .	16 88 89 62		1*38
March	1'27	0'14	ti gt	4t 82		1'45

The following are the results of observations of hydrogen prominences '--

28gz	Number	Prominences			
	of days of observation	Mean number	Mean height	Mean extension	
January	13	4 62	36 ["] 9	1,3	
Fehruary	22	7.55	44 I	1.8	
March	. 17	6 t2	40 1	1.2	

When these numbers are compared with those obtained for When these numbers are compared with those obtained for the last three months of 1890, a marked increase is apparent. In addition to this the results obtained for spots, faculte, and pruminences indicate that a secondary maximum of solar activity occurred during the month of February.

ACTIVITY Occurred quering the month of February.

THE CONSTANT OF ABBRATTON —A short them go MM. AND THE CONSTANT OF ABBRATTON —A short them go MM. AND THE CONSTANT OF ABBRATTON AND THE MET ADDRESS OF A SHORT OF ABBRATTON AND THE MET ADDRESS OF ABBRATTON OF ABBRATT

ANIMAL LIFE ON A CORAL REEFS

IN nearly all the shallow waters of the tropical seas there is an abundant fauna, but nowhere is there such a crowd of marine animals of all kinds as there is in the region that extends manne animals of all kinds as there is in the region time extends from the growing edge of the coral reef to a depth of some to or 15 fathoms beyond it. This may be due to the fact that in this region there is plenty of light and heat, no great or sudden changes of temperature, or of the chemical composition of the water, and there is an abundant food supply brought by tidal currents from the surface of the ocean. Here it is, then, stall currents from the surface of the ocean. Here it is, then, that we find the richest fauou. Here it is that the struggle for existence is most severe, and here it is that the animals are protected and concealed by the most pronounced marks and colours, and provided by Nature with various forms of amourt, stings and spines to defend them in the battles with their cremises.

One of the most interesting results of this severe struggle for Abstract of Lecture by Dr S. J. Hickson, delivered at the London Institution, January 22, 2841.

existence, or perhaps it would be more correct to say of the large number of species competing for existence, is the important faunistic difference that may be observed between one reef and -nay, indeed, between one part of a reef and another part of the same reef.

smother—say, indeed, between one part of a reef and another part of the same reef.

Darwin long ago pointed out that in the straggle for existence svery slight deviating gained by any one of the competing follows that a very slight though constant difference in the physical conditions, such, for example, in the case of coral reefs, as rapidity of tidal currents, amount of surf or character of the physical conditions, such, for example, in the case of coral reefs, as rapidity of tidal currents, amount of surf or character of the family. The real reef is the surface of the surface of the family of the constant of the surface of the family of the constant of the family of the constant and reference in the family of the constant and refound on the reefs of North Celebes belong to two great orders—the Zoansharas and Agyonaria. The prevaling color of the Iving Zoansharas some cases the growing or younger branches as a whole, may be very highly coloured. White, pink, emerald green, violet, and blue, are colours frequently met with in different parts of the Zoansharas notdown. The surface of the violet parts of the Aleyonaria. The tentacles of the polygo of Tubpora, for the Department of the constant on the colour of the stop parts of the Aleyonaria. The tentacles of the polygo of Tubpora, for the bown. A species of Sarcophytum, spain, common on the shores of Celebes, showed green and greenshyellow and yellow samples within the same half-mile of reef. All of these coal colours, with the exception of the colour on the shores of Celebes, tho wed green and greenshyellow and yellow samples within the same half-mile of reef. All of these coal colours in this study, also become in the study of the colour of the spicules mentioned (longed immention in this study, also bown. above, are soluble in spirit, the soft parts becoming, after pro-longed immersion in this fluid, pale brown. The alcohol extracts of a considerable number of corals have now been

extracts of a considerable number of corals have now been submitted to spectrum analysis, and the bands they exhibit show consistency and the same statement of the colours of the corals are experimental evidence as present that proves that he colours of the corals, nor, indeed, of the sponges, are extended to the protective or warning infunction. It seems much more probable that these brilliant colours represent different stages in the building.

that these brilliant colours represent different stages in the building up or breating down of some complex chemical substance that up to restain the stages of the stages and those of them that seem to live habitually among the corals of the reef are characterized by the possession of very curious

of the recei are characterized by the possession of very curious spots or attripes and very brillant colours. Soon after my arrival in Talisse a large lobster was brought to me marked by broad transverse bands of blue and white, a large Squilla is not uncommon marked with aimlar bands of white and deep purple, and the little prawn Stenopus hispidus, that I found in a tidal pool close to a reef, has bands of red and that I found in a tidal pool close to a reet, has bands or red and white. The cephalopods have also peculiar markings. One specumen that I found, Octopus: lianulaiss, had large blue spots over its body and arms. The fishes, again, are marked with spots and stripes of various kinds and many brilliant colours.

Without going too deeply into the argument, we are justified in saying that these animals are so marked and coloured because in saying that these animals are consisted and coloured because they live among the billiant surroundings of the couri level, or, to put it in another way, animals similarly organized and of similar habits would be at a disadvantage on the coral refs if they were not so marked and coloured. The other fashes of the test of the consistency of the consiste the surroundings.

Most of the colours must be considered to be concealment

NO. 1126, VOL. 447

colours Stenopus hispidus, though so very conspicuous when colours Stranger Inspiritus, though no very compresses when taken out of the water, was extremely difficult to see in the pool where I found it is about, in all probability have finished to within y take I found it is a substantial to the property of the that are coloured blue are much less readily seen than the gold, yellow, and red varieties, but an examination of the fish that I yearow, and rec variences, not an examination of the mai that it caught myself, and were caught for me by the natives, showed that the fish in which blue is the prevailing colour are much more frequent in the very shallow water, while those that were caught in water from 15 to 20 fathoms were more frequently red or yellow. The blue colour scems to be a protection for the caught in water from a constraint of the fish from air-breathing enemies—the eagles, ospreys, and hawks—and as these enemies can only approach them from above, the colours are frequently confined to the dorsal sides. The red and yellow colours of the fish seem to be a protection from animals, such as the sharks, perch, and other carmovorous fish, that approach them from the deeper waters beyond the reefs. Thus red and yellow fishes rarely have these colours confined to the upper sides, and many of the blue fishes are coloured red or

yellow ventrally
It is difficult to frame any general rule to account for the It is difficult to frame any general rule to account for the curious distribution of the colours of these animals in spots and stripes Speaking in very general terms, for there are many executions, the fit hath browse on the cornis, possessing small fish, and Surgeon), are striped, those that feed on other fish, and have large months armed withfearmiverous teath, such as the Sermaldie, are aported. The only examined of what appears to be a strange colour that the striped of what appears to be a strange colour that the striped of what appears to be a strange colour that the strange colour than the strange colour that the strange colour that the strange colour that the strange colour than the strange colour that the strange colour that the strange colour that the strange colour that the strange colour than the strange colour than the strange colour that the strange colour than the strange colour than the strange colour that the strange colour than the st

I have noticed occurs in connection with the spines on the tails of certain Surgeons and Trigger fish Annihurus achilla, for example, has a uniform purple colour, but there is a bright red patch surrounding the formidable tail spines that give these fish the name of Surgeons. Similar warning colours are very pro-nounced also in Nateus unicormis and Nateus lituratus, and in some of the Ballistick

WASHINGTON MAGNETIC OBSERVATIONS.

THIS volume contains the results that have been obtained from the magnetic observations taken at the Naval Obser vatory during the years 1838 and 1859. The instruments which they were made were, in the year 1837, placed in their respective buildings that had been erected for that purpose the Bureau of Navigation. In the construction of these buildings that had been rected for the purpose the surface of the second of the the Bureau of Navigation. In the construction of these buildings the greatest care was taken to insure the complete elimination of local disturbances. No tron or any magnetic material was used at all, and the faxtenings, &c., were entirely of copper, brass, and wood; even the stoves, in which only wood was

hurnt, were of soap-stone, with copper pipes.

The instruments that were employed consisted of a declinometer, theodolite, portable magnetometer, dip eircle, a set of meter, incodoline, portanous magnerometer, dip errore, a set or self-recording magnelographs, a seismoscope, and seasongraph; each of them, with the exception of the last two mentioned, being set on piers based on concrete, and in no way conarcted with the floors of the buildings. To complete the equipment, a compast-tetting stand is placed on a pier north of the theodolite, compast-testing stand is placed on a pier north of the theodolite, and is capable of motion in an east and west direction. By means of an arm carrying two prisms that have adjusting screws, the opposite marks on the compast card can be placed in the field of view of the theodolite when the latter is directed on the prisms. All the observations, which are represented in tabular form, denote the results that have been obtained after applying form, denote the results that have been coltained after applying all necessary corrections. The tables include, among others, the mean hourly values of the horizontal and vertical force for each month of 1889, and of the declination for each month of 1888 and 1889, the last of which are taken from the monthly curves; declination ordinates for each hour, in minutes of are

taken from daily declination traces; hourly values of horizontal "Appendix I -- "Magnetic Observations " By Eusign J A Hoogewerff, U S. Navy. (Washington . Government Printing Office, 1890) NO. 1126, VOL. 44]

and vertical force in absolute measure with all corrections, ob servations of horizontal intensity and dip, with a summary of disturbances in declination which differed two minutes or more

dausthances in declination which disteres two minuses or more from the mean mostly carre. No less important is the series of the fourteen large plates at the end of the volume. The first shows the way that the daily photographic traces of declination, horizontal and vertical forma-photographic reases of declination, horizontal and vertical forma-variation of the magnetic elements for the year 1889. In this latter plate the curve that gives the integration of these elements— — that oversit the mean durant lotal force—fromg out the that is, that gives the mean durnal total force—brings out the fact that in every twenty-four hours there are two maxima and two minima, these latter two occurring between midnight and noon (75th meridian mean time).

Den 1751 meridian mean time).
Plates ni, to vi melusive show the traces of the monthly imposite curves of declination for the two years.

In Plates vis. to xiv most interesting comparison is made of the disturbed days of declination taken from observations at Washington, Los Angeles (California), Toronto (Canada), and Pawlowsk (Russia). the curves are all computed for the same time (i.e. for the 75th meridian west of Greenwich), and reduced to the same length of base line. Although on the whole the to the same length of base line. Although on the whole the urvers show a more or lest equal variation, yet there are some cases in which a decided local variation has taken place. For o'cleck (15th needfant time), the magnetic declination at Washington, Los Angeles, and Toronto, shows only slight variations, Los Angeles, and Toronto, shows only slight variations, Another very interesting case happens on March 17t, when the curves traced at Washington and Toronto are quite similar to echo their, but different from those treed at the other two places: the curve showing the magnetic disturbances in declination at Pawlowsk being very similar to that indicating the horizontal force at Washington

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE,—The subject of the Rede Lecture, to be given by Sir Alfred Lyall on June 17, is "Natural Religion in

The General Board of Studies have again brought forward proposals for the increase of the stipends paid to University ecturers and Demonstrators in Natural Science, which had to

be postponed last year owing to want of funds

Mr. A Hutchinson, Demonstrator of Chemistry in Caius College, has been recognized as a Teacher of Chemistry with reference to the regulations for medical degrees

A Syndicate is proposed by the Council of the Senate for the purpose of considering whether any alternative for Greek should be permitted in the Previous Examination. This is sure to rouse much agitation, but it may be hoped that the long-vexed question will at length be settled in a liberal sense

questions was a tengin no settied in a nortal sense.

Another Syndricate is to consider the office of Superintendent of the Museums of Zoology and Comparative Anatomy, about to be vacated by Mr J. W. Clark, Registrary Some rearrangement of the duties, &c., is considered destrable

SCIENTIFIC SERIALS

American Journal of Science, May -On the relationship of American journals of Science, May — On the relationship of the Plestoceneto the pre-Plestocene formations of the Missis-supple basin, south of the limit of glacation, by T. C. Cham-berlam and R. D. Sali-bury — On certain in measures of the subcastly of solar radiation, by William Ferrel — The author above that many measures of the intensity of solar radiation are shows that many measures of the intensity of solar radiations are of uncertain value. He specially discusses M Crow's curves of the relative intensities of solar radiation, obtained at Montpellier with a modelide form of the thermopile, called the regularing with a modelide form of the thermopile, called the regularing Horace V. Winchell.—On a self-feeding Sprengel pump, by H. J. Wells —Contributions to meneralogy, No 50, by F. A Genth; with crystallographic notes by S. I. Penfield and I. V. Persson. The composition and shalt of the following minerals are given: three new varieties of axions, endistyre, and montteelling, and timine from Angent Core, Arkansas—montteelling, and timine from Angent Core, ArkansasContributions to mineralogy, No. 51, by F. A. Genth. A new species, which has been named aguilante, is described. It appears to be a cupriferous stephanite with an admixture of metallic silver —Columbite of the Black Hills, South Dakota, by W. P. Blake -The raised reefs of Fernando de Noronha. by W. P. Blake — 10e raised recist of Fernance us crowmans, by Henry N. Ridley.—The cause of active compressive stress in rocks and recent rock flexures, by T. Mellard Reade.—A new phosphate from the Black Hills of South Dakots, by W. P. Headden — Note on certain pecularities in the behaviour of a galvanometer when used with the thermopile, by Ernest Merritt —Supplementary notice on the polycrase of North and South Carolina, by W. E. Hidden and J. B. Mackintosh

THE American Meteorological Yournal for March contains:— An article by S. M. Ballou, on Prof. Russell's theory of cold waves, published in the Report of the Chief Spand Officer for 1889. This article ha report of a paper read at the meeting of the New England Meteorological Society on January 20 last According to Prof. Russell's theory, the cause of the cold area from which the cold wave is drawn is held to be a preliminary strong upward diminution of temperature in the air, a subsequent strong upward dimination of temperature in the air, a subsequent overtaming, bringing the cold air to the surface and producing overtaming, bringing the cold air to the surface and producing producing high pressure. The author points out that each of these assumptions would probably be questioned, and the considers each of them in detail, quoting from the works of the considers each of them in detail, quoting from the works of the considers each of them in a straphyton of the substance of a reply by Dr. Hann, in the Miteorologicals Zuitakryft of September 1890, or the criticism of FPO Hasses. These papers have already been noticed at length in NATURE.

SOCIETIES AND ACADEMIES. TANDAN

Royal Society, April 30 — "The Passive State of Iron and Steel, Part III." By Thos Andrews, F.R.S. M.Inst.C E Sense V. Set I. Relative Paisonly of Wrought-west and various Steel Bars, and the Influence of Chemical Composition and Physical Structure on their Pairs State in Cold Nation Acid -The passive state of iron or steel may have hitherto been regarded by many as a sort of fixed property pertaining to iron and steel alike, when immersed in cold strong nitric acid. The following experiments were made to investigate if the passivity was of a universally static character, or whether it varied with the chemical composition and general physical structure of the

metal, and, if so, to what extent
The experiments of Series V., Set I, were made on bars of
the various steels selected from the author's standard samples. The bars were cold drawn through a wortle, and were therefore different in physical structure to the rolled plates used in the second series of the experiments. An idea of their general properties will be obtained on reference to Part II, Tables IV. properties will be obtained as the second of their general properties will be obtained for reference to Part II. Tablest IV. Applied VA. Applied badd for reference to Part II. Tablest IV. Of the steel to be tested was placed in the wooden stand will along with a polithed wrought iron bar of equal size, and the pair were then immersed in if fluid ounce of intime cold, with the particular to the part of the particular to the

The wrought-iron bars used in each experiment were cut from one longer polished rod, so as to afford a fair comparison of the relative passivity of the various steels, compared with the wrought iron and also with each other. The results are the

average of numerous experiments in each case.

The experiments of Series V., Set 1, on the relative pa-sivity of wrough 1:ron, soft cast-steel, hard cast-steel, soft bessemer steel, and tungsten steel, showed that wrough-1:ron well-cictor. positive to the steels with a considerable E.M.F., the wrought-iron being thus shown to be less passive than the

Series V, Set 2 Relative Passivity of Wrought-iron and various Steel Plates in Cold Nitric Acid, sp. gr 1'42.—In the following series of observations, the metals experimented upon consisted of plates of rolled wrought-iron, rolled ateels made by the Bessemer, Siemens-Martin, or crucible east steel processes, such as soft cast-steel, hard cast-steel, soft Bessemer steel, hard

Bessemer steel, soft Siemens steel, hard Siemens steel, and they are of the chemical composition given on Table VII. The terms "soft" and "hard" relate only to difference of percentage of combined carbon, and not to their having undercentage of combined carbon, and not to their having under-gone annealing or hardening processes. Each piate was 3 inches square, by anch thick = total area of exposure 195 square inches including edges, brightly polished all over, and had a long thin strip left on the top ude, for convenience of attaching to the galvanometer connections. The whole of the wrength-tron plates, used as elements with the various steel plates, were cut from one larger wrought-iron plate, and were thus practically of uniform composition, thus ensuring an accurate comparison of the relative pas-ivity of the wroughtan accurate companson of the relaire pas-inty of the wrought-ton compared with the different types of steels, and at the same time indicating relatively the influence of varied composition and atractive on the passivity of the different classes of steels under observation. In each experiment, a polished wrought-tion plate and a polished steel plate were firmly placed in two or plate and a polished steel plate were firmly placed in two procession was to be a possible of the place of the plate was then carefully placed clovely over a porciain vested containing. If shull do unces of inter and, sp. gr. 1.42, the plates being fully immersed in the acid, and the portoring whaths of the base connected in circuit with the guivanometer. The electro-chemical effects observed were then Table VIII. and indicated that worcely time was see passive Table VIII, and indicated that wrought from was less passive than the steels, and further demonstrated that steels of a higher percentage of combined carbon are more passive than those of a lower percentage of combined carbon.

lower percentage of combined carbon.

Gmen al Kemarks — It has been necessary to give in modified iteral the effects observed during the pends of experimentation of the effects observed during the pends of experimentation an accurate infinite interest of the research, and a brief résismé of some of the principal results and conclusions arrived at by the author up to the present time may now

e given.

(1) The experimental observations of Part I, Series 1, idicate that the influence of magnetization on the passive state of steel rods in cold nitric acid, sp. gr 1 42, is not very great, but it was detectable with the delicate galvanometer and by the sensitive electro-chemical method pursued by the author in the investigation

investigation

The effect of magnetization is more marked in warm nitro and and when the iron x in a powiered state, as shown in the control of the control

state, magnetized steet part were rather test passave in meaning and than unmagnetized ones

(3) The results in Part II, Series III, show that the passivity of both unmagnetized wrought-tron and unmagnetized steel in nitric acid, sp gr. 142, is considerably and proportionately re nutrie acus, sp gr. 1 42, is considerably and proportionately reduced as the temperature of the acid increases, until the temperature point of transition from the passive to the active state is reached at a temperature of about 195. F, and it was also found that the wrought tron was less passive in the warm nitro-acid than cest-tated (See also remarks at foot of Diagram I. in Part II)

(4) The results of the observations of Part II., Series IV, icate that Scheurer-Kestner was, to some extent, in error in regarding the passivity of iron as not dependent on the greater or less degree of saturation of the acid. The author's experi-ments briefn recorded have shown that the passivity of the metals employed, viz. wrought iron, soft cast-steel, hard cast-steel, soft Bessemer steel, and tungsten steel, was very materially increased with the concentration of the nitrie acid; and it was also observed that wrought-iron was much less passive in the nutrie acid of less concentration than most of the steels, the soft Bessemer steel being found about equal in passivity to the wrought-iron under the conditions of experimentation. A reference to Table III shows that a considerable amount of EMF, was developed between the various metals in every instance, which is a circumstance of much interest in connection

instance, which is a circumstance of much interest in connection with the passive state of ron and steel.

(5) The results obtained in Part III, Series V and VI., on the relative passivity of wrought-iron and the various steels—soft cast-steel, hard cast-steel, soft Bessemer steel, hard Bes semer steel, soft Siemens steel, and hard Siemens steel-are of semer steel, sort Siemens steel, and narn Siemens steel—ale of an important character, showing, by the delicate electro-chemical method employed, the sensitive influence of difference in chemetnou employed, the sensitive influence of difference in che-mical composition and physical structure, &c., on the passive state of the metals. Generally throughout this series of experi-ments it will be observed that the wrought-tron was electro-positive to the steels with a considerable E.M.F., amounting, in some cases, to as high as one tenth to one-seventh of a volt. the wrought from being thus shown to be less passive than the

steels, defence to the experiments in the wrought-iron and various sized plates, on Table VIII. shows that the E.M.Y between the passive wrought-iron and the various soft steels, which contained less percentage of combined earbon, in circuit in cold intre said, sp. gr. 142, was very considerably less than the L.M.F. under similar conditions between the wrought-iron. E. M.F. under similar conditions between the wrought-iron plates and the different hard such saving a higher percentage of combined carbon. The latter results, therefore, demonstrate the interesting crumstance that steels of a higher percentage of combined carbon are more passive than those of a lower percentage of combined carbon. It will be observed that the wrought iron was also electro-positive to most of the steels, whether of a higher or lower percentage of combined carbons. which shows that wrought-iron may be regarded as generally less passive than steels

May 14.—" Researches on the Structure, Organization, and Classification of the Fossil Reptiha VII Further Observations on Pareassaurus" By H G Seeley, F.R.S, Professor of Geography in King's College, London All the affinites Intierto attributed to Pareassaurus with

ally rinthodonts. Anomodonts. Procelephon, and Mammals are Laty nuthodonts, Anomodonts, Procelophon, and Mammals are shown more strongly in the several parts of the skeleton, by the new evidence The shoulder-girdle is more Labyrinthodont than was previously supposed, the skull is more Reputilan, and the pelvis and limbs are more Mammalian, though with some resemblance to Dinosaurs

From furthur evidence of the structure of the skeleton in Procelephon, the author regards that type as a member of the Pareiasauria, rather than as forming a distinct sub order. It also has four sacral vertebrae

The divisions of the Anomodontia are grouped as-



Physical Society, May 9 - The Society varied its ordinary procedure by paying a visit to the ancient seat of learning situated on the banks of the Cam. Assembling at Liverpool Street Station, members and visitors to the number of about one hundred were conveyed in saloon carriages by the II one hundred were conveyed in asloon carrages by the 11 of o'clock express direct to their defentiation, the whole journey o'clock express direct to their defentiation, the whole journey those present were Dr. E. Aklimon, Prof. Ayrton and Mrs. Hukerharton, Mr. Miller Bally, Mr. Sellerde Blasel and Mrs. Blakerlawdl, Mr. D. J. Blakley, Mr. T. H. Blaketley and Mrs. Blakerlawdl, Mrs. Blakerlawdl, Mrs. Blakerlawdl, Mrs. Tranklamd, Dr. W. R. Hodghuson, Prof. O. J. Lodge, Mrs. Frankland, Dr. W. R. Hodghuson, Prof. O. J. Lodge, Frof. Meldolp, Prof. Perry and Mrs. Frankland, Dr. W. R. Hodghuson, Prof. O. J. Lodge, Trof. Meldolp, Prof. Perry and Mrs. Thompson, Mr. A. F. Sumpore, Prof. S. T. Thompson and Mrs. Thompson, Mr. A. F. at the historic town the party became the reuses to the Camrotter and sith. Frotter, and Mr. O. M. whipple. On arriving at the historic town the party became the guests of the Cambridge members, and proceeded to Emmanuel College, where they were received by Mr. W. N. Shaw. Various groups visited the clouters, chippel, and gardens, and at one o'dook tunch was provided in the College Hall At 2. 20, a meeting of the Society was held in the Lecture Room of the Cavendh Laboratory. The papers read were all by sathows resident

in Cambridge, and the abstracts given below will sufficiently indirect the variety of the subjects brought before the Sonety to the control of the control o can be compared; and the new air condensers to be used by Mr Glazebrook as standards The Cambridge Scientific Instrument Company had an interesting exhibit, including a dividing engine, Boys's radio-micrometer, electrically driven tuning forks, engine, Boys's radio-micrometer, electrically driven tuning firsk, and various recording instruments, amongst which was Galton's apparatus for registering the growth of plants. Other things which attracted attention were Glazebrook's spectrophotometer, Lord Rayleigh's coils and apparatus used in his determination of Loru rayengus coust and apparatus used in his determination of the ohm, a collection of models, medals, and instruments, formerly belonging to Prof Maxwell, the resistance standards of the British Association, together with the historic rotating coils and electrodynamometer used in the determination of the BA unit. Tea was served in the Combination of the Trinity College, and a majority of the visitors returned to town Trinty College, and a majority of the visitors returned to town by the 8 o'clock express, greatly pleased with the day's oating. Others, however, prolonged their visit intil Monday, and had opportunities of discussing important physical problems with the Cambridge members. The meeting was in every sense a great success, and will long be remembered as a red letter day in the history of the Society - At the secure meeting, held in the Cavendish Laboratory, Prof Ayrton, F R S, President, in the chair, the following communications were made -S experiments on the electric discharge in vacuum tubes, by Prof J J thomson, F R S The phenomena of vacuum discharges were, he said, greatly simplified when their path was wholly gaseous, the coundication of the dark space surrounding th negative electrode and the stratifications so commonly observed in ordinary vacuum tubes being absent To produce discharges in tubes devoid of electrodes was, however, not easy to accomplish, for the only available means of producing an electromotive force in the discharge circuit was by electro-magnetic induction Ordinary methods of producing variable induction were value less, and recourse was had to the oscillatory discharge of a Levden iar, which combines the two essentials of a current whose maximum value is enormous, and whose rapidity of alternation is immensely great. The discharge circuits, which may take the shape of hulbs or of tubes bent in the form of coils, were placed in close proximity to glass tubes filled with mercury, which formed the path of the oscillatory discharge. The parts thus corresponded to the windings of an induction coil, the vacuum tubes being the secondary and the tubes filled with mercury the In such an apparatus the Leyden jar need not be large, and neither primary or secondary need have many turns, for this would increase the self-induction of the former and lengthen this would increase the self-induction of the former and lengthen the discharge path in the latter forcessing the self-induction of the primary reduces the E.M.F induced in the secondary, whilst lengthening the secondary does not increase the E.M.F per unit length. Two or three turns in each were found to be quie sufficient, and on discharging the Leyden jar between two highly polished knobs in the primary circuit a plain uniform band of light was seen to use young the exhausted bulb containing traces of oxygen was placed within a exhausted but containing traces of oxygen was placed within a primary spiral of three turns, and on passing the jar discharge, a circle of light was seen within the halb in close proximity to the primary circuit, accompanied by a purplish glow which lasted for a second or more. On heating the balk, the duration the glow was greatly diminished, and it could be instantly extinguished by the presence of an electro-magnet. Another exhausted bulb surrounded by a primary spiral was contained exhausted bulb surrounded by a primary spiral was contained in a bell jar, and when the pressure of air in the jar was about that of the atmosphere, the secondary ducharge occurred in the bulb, as is ordinarily the case. On exhausing the jar, however, the luminous ducharge grew fainter, and a point exhausted to the bulb or jar the excondary dechange to appear exhausten of the lar caused the secondary dechange to appear exhausten of the lar caused the secondary dechange to appear exhausten of the bulb or jar the author could only explain on two suppositions, viz. that under the conditions then existing the special inclusive capacity of the gas was very great, or that a dechange could pass without being luminous. The author could be considered that the special caused the passage of the could be considered that the could be considered to th out electrodes sacressed as the pressure diminished, until a certain

point was reached, and afterwards diminished again, the above the temperature of the electrodes. One peculiarity of way due to the presence of the electrodes. One peculiarity of many different peculiarity of the present peculiarity of the present peculiarity of the present peculiarity of the present peculiarity of the peculiarity of t oint was reached, and afterwards diminished again, thus showthe ions, by Mr. W. C. D. Whetham. In studying electrolysis the question as to whether there is any transference of solvent when a porcous wall is absent presented itself to the author. The ordinary methods of testing for transferences, such as by increase ordinary methods of testing for transferences, such as by increase disparages, the surbor used different coloured solutions of the same salt, such as cobal chloride in water and in acholol, the former of which is red and the latter blue. By putting the solutions into the and U-shaped these any tangen in the position of the line of junction of the two liquids could be necessarily recognitions and the same water was the same ware former to the same water to be same water to the same water to be Two aqueous solutions in which the amon was the same were also inted, one combination being cupric chloride and common salt, and in this case the line of demacation traversed about 7 inches in their bours. The results intherio obtained by this method agreed faithy with those found by Kohlmusch—On the reasstance of some mercury standards, by Mr. R. T. Glaze-the reasstance of some mercury standards, by Mr. R. T. Glazethe resustance of some mercury standards, by Mr. R. T. Glassroot, F.R.S. 18 in 1885, M. Benoit, of Paris, supplied the stuhor with three mercury standards, noninally representing the Paris Chopress olm, now commonly homes as the legid olm. Tests and the control of the common standards of the Paris Handward of the Chopress old, and the Chapter of the Chapter of the Chapter old, and and the Chapter old, and That shows that within the limit of experimental error the fusion of the metrory standards to the BA. Acids have remained practically unchanged during air years. The numbers given above are based on Lord Rayleigh's determination of the specific resustance of mercury, which differs appreciably from that found concordant determinations, the values of the mercury standards expressed in legal ohms become (No. 37) 1 00033 and (No. 39) 09995. The values given by the maker were 1 00045 and 0 09954, respectively, showing a very close agreement. The sustine also found that refilling No. 37 from the same sample of mercury produced to appreciable change in its resistance, when ments on the co-efficient of increase of resistance of fusercury with ments on the co-efficient of increase of resistance of mercury with temperature gave the value o 000872 as the mean coefficient between o' and 10° C., a number rather less than that obtained between o' and to' C., a number rather less than that obtained by Kohlrauch —Oa an apparatus for measuring the compressibility of liquids, by Mr. Skinner. The apparatus consisted of a large phenoid flask, with a long narrow neck containing the communication through a stopcock and fleshle tabe with an adjustable reservor. By rasing or lowering the latter the flask could be easily filled or empited or the quantity of liquid dispited. The flash was inclosed in a bell jay, whose interior produced by blowing into the jar caused the liquid to descend about 1 continued to the control of the liask. This movement is the control of the light of the control of the light of the control of the liask. This movement is the control of the liask. This movement is the control of the liask. This movement is the control of compressibility had been tested as different to the control of compressibility had been tested as different to the control of the contro corresponded with a change of volume of about half a millionth. The coefficient of compressibility had been tested at different The coefficient of compressibility had been tested at different temperatures, and the results were not very different from those obtained by Tart and others. The influence of salts in solution great difference in this respect found between electrolytes and non-electrolytes.—Some measurements with the pneumatic bridge, by Mr. W. N. Shaw. The action of the paparates is analogous in many respects to the Wheatstone's bridge, and its object is to comparate the pneumatic resultances or conductivities.

of various orifices, channels, tubes, &c. The proportional arms are represented by two circular holes in than plates of much, the sake by a serve, and the fourth might consist of any aperture or tube whose conductivity was to be determined. The servent apparence are presented by large worden boxes apparence are presented by large worden boxes of the contractivity itself at right angles to the tube when no air current is passing. itself at right angles to the tube when no air current as passing. The apparatus is remarkably sensitive to movement of the abutter, and on starting or stopping the draught after balance that been obtained, effects analogous to those produced by self-abutter, and the sensitive of the self-abutter and the sensitive of the self-abutter of the sel afterwards diminishes with further increase of length. Putting a lange on the outlet and reduces the anomalous effect, while a bevelled mouthpixed similarly placed causes it to disappear. In the discussion on Prof. Thomson's paper, Prof. Privgerald and the beautiful experiments were likely to lead to very improgram to the control of t the write was on the ade remote from the primary, and if there was any great increase in specific innuctive capacity, be would for further information as to the action of the magnet in preventing the after glow, and in some cases precipitaling a luminous ducharge. The experiment with the exhausted bulb may be action of the contract Thomson had tred Mr. Crookes's experiment, in which the electric pressure necessary to produce a duckage was greatly electric pressure necessary to produce a duckage was greatly Prof. Thomson, in reply, said he had not tried the experiment, but the phosphoresence he had observed was of quite a different character from that produced in Mr. Crookes' tubes. To Prof. character from that produced in Mr. Crookes' tubes. To Prof. of the glow, but he believed the glow to be due to a combination which might be prevented or facilitated by the action of the magnet causing the density to be different in different parts of magnet causing the density to be different in different parts or the bulb. M. Guillaume, in discussing Mr. Senner's paper, described the methods used by Sabine, Jamin, and others, in determining the compressibility of liquids, and pointed out their defects. The chief difficulty in such experiments was in finding the compressibility of the reservoir. Numbers expressing the compressibility of mercury obtained by different observers were compressibility of mercury obtained by different observers, were given, the best values avarying between cooccopy and coccope, —On the motion of Prof. Ayrion, seconded by Prof. Rucker, a hearty vote of thanks was accorded to the authors for their valuable and interesting communications, and for the kind manner in which the Society had been received and entertained by the Cambridge members Prof. Thomson and Mr Glazebrook acknowledged the vote

Geological Society, May 6.—Dr. A. Geikie, F.R.S., Freudent, in the chair —The following communications were read—One Rhesio, by E. Wilson. In a deep railway-cutting at Pylle Hill or Totter Down Brisio, by E. Wilson. In a deep railway-cutting at Pylle Hill or Totter Down Gets, are exposed between the Tea Green Maris and the Lower Liax. There is no doubt as to the division between the Rheute and Keeper beds in this section, but the line of demarcation between the Rheute and the Lass has always been a matter of the Common than the Common that the Common than the Common t

sharp line of demarcation between the former and the Avicula sharp line of demarcation between the former and the Attendate construct Shales. Most of the characteristic Goalist of the British which are new to England, and some of lines possibly to access A desiable section of the subdivisions of the Rhestic and adjacent beds, and a list of Rhestic Iosuis found in the section are given beds, and a list of Rhestic Iosuis found in the section are given provided to the subdivision of the Rhestic London provided to the subdivision of the Rhestic London provided to the section of the subdivision beds, and he had been considered to the subdivision provided to the subdivision of the Rhestic London provided to the subdivision of the Rhestic provided to the Rhestic pro study of the Interior Collect of the Cotteswood Hins, including the residues insoluble in hydrochloric scid, by Edward Wethered. The author gives the following main divisions of the Inferior Collic of the Cotteswold Hills in descending order:—

Ragstones Upper Freestones, Oolitic Marl, Lower Freestones. Pea Grit.

Transitton Beds resting on Upper Lias.

Transition Beds resting on Upper Lias.

The strial are described, and the results of microscopic cramination of the different hed given. These latter confirm the author's aver as to the important part which Gressrells have taken a transition of the different hed given. These latter confirm the author's transition of the proper than the bornegs referred to by Frof. Judd an the discussion of Mr. Strahan's paper, "On a Phosphate Chalk," comvenes the author that these have no connection with the genus Gressrells self-after contain, cheftly detrited quartt, felipara, arroom, tourmaine, chapter of garden, and occasionally rutle. In the explicacous beds silected alumnas was found to occur plentially. The latter of the present of the quantity of residue and the size of the quarter grains in the following the present of the pres

		of residue	quarta grains,
Ragstones	٠.	28	'17
Upper Freestones		1.1	12
Ooliuc Marl		3.5	'09
Lower Freestones		ĭ 8	113
Pea Gnt Series		50	'14
Transition Beds		38.3	'13

This shows a great falling off in the percentage of revidue above the Transuton Beds. That of the Freetoness irremarkably ow, and it would appear that these rocks were formed under condi-tions which allowed of very little sediment being deposited. The paper gave rue to a discussion, in which Prof. Hull, Mr Richerdge, Mr, H. B. Woodward, the Rev. H. Wanwood, and the author took part

Royal Meteorological Society, May 20—Mr. Baldwin Latham, Prevident, in the chair—The following papers were read;—On the vertical circulation of the atmosphere in relation to the formation of storms, by Mr. W II. Dines. After giving an outline of the circulation of the atmosphere, the author refers to the two theories which have been suggested to account for the to the two incortes which have neen suggested to account or the formation of somm, viz. (1) the convection theory, which is that the central air ruses in consequence of its greater relative warmth, this warmth being produced by the latent heat set free by condensation, and (3) the theory that the storms are critical eddies produced by the general motion of the atmosphere as a whole, just as small water eddies are formed in a flowing stream of water. The author is of opinion that the coverection theory is the more probable of the two, but more information about the take more probable of the two, but more information about the temperature of the upper are is greatly needed.—On Brocken spectres in a London log, by Mr. A. W. Clayden During the dense fogs in February last, the author made a number of experiments with the view of rasing his own spectre. This he ultimately succeeded in accomplishing by placing a steady himself in the control of the second of the form of the them made some careful measurements of the size of the first first them made some careful measurements of the size. and distance of the spectre, and also succeeded an taking some photographs of the phenomenon.—An account of the "Leste," or hot wind of Madeirs, by Dr. H. Coupland Taylor. The "Leste" is a very dry and parching wind, sometimes very hot,

blowing over the usland from the E.N.E. or E.S.E., and corresponds to the sirectoof Algera, or the hot north winds from the deserts of the interior experienced in Southern Australia. Grant of the control of the contr Shelford Bidwell, F.R.S., exhibited an experiment showing the effect of an electrical discharge upon the condensation of steam. The shadow of a small jet of steam cast upon a white wall's, under ordinary conditions, of feeble intensity and of a neutral tut. But if the steam is electrified, the density of the shadow titl But if the steam is electrified, the density of the shadow is at once greatly increased, and it assumes a peculiar orange-brown hue. The electrical discharge appears to promote conclusions of the exceedingly municiparticles of water continuous control of the more refinagible rays of light. It is suggested that this experiment may help to explain the intense dischesses, offen tempered by a lurid yellow glow, which is characteristic of thunderdoolds.

Linnean Society, April 16.—Prof Stewart, President, in the chair,—A paper by the Rev. F. R. Wilson, was read, on lichens from Victoria, in which several new species were described, ischess from Victoria, in which several new species were described; specimens of which were exhibited.—A paper by Surgeon-Major specimens of which were exhibited.—A paper by Surgeon-Major viz. P. cormate, Corda, and a new species which the author proposed to name P. Jammi-chryptogeon. A feature of peculiar interest noted in the latter species was the extra-ordinary abundance and wide distribution of the teleutopra-ordinary abundance and wide distribution of the teleutoprastage as compared with the comparative scarcity of the acidial

suge a compared with the comparative variety of the excitate stage, and this disproportion in the distribution of the two stages had been remarked by the author long before he had accretained that they were related. A discussion followed, in which several of the botanist present took part — Poof. B. J. Anderson exhibited a panoranic arrangement for duplaying drawings at biological fectures.—Mr John Young exhibited a nest of the Bearded Timouse (Cadamphilas harmura), which had been built in his aviary Several aggs were laid, but none extend speciment of a Cooklears from Ben Mone, believed to be undescribed — Mr Robert Deane forwarded for exhibition a plant of the Rayless Dany, found growing abundantly in the neghbourhood Carrilli 3 and an undetermined Sponge, dresigned in about, of fathoms, of the coast of South Wales—Mr D. Locast of Devonshire Although figured so long ago as 1640 by Classias, and whalequently noticed by opher observers, the plant coast of Devonshure Although hyured so long ago as 1640 by Classis, and subsequently noticed by other observers, the plant yielding it had only lately been identified by Mr. J. H. Hart, of Trainfad, as Scapellett amazonica Mr. Morris likewise exhibited specimens of the fruit of Catastiemma fragrans, received for the first time, from St. Vincent, showing its rure position to be amongst the Macazos, tribe Bombacas—Mr. Thomas Christy exhibited some Kolis nuts, and made remarks on the Christy exhibited some Kola nuts, and made remarks on the properties attributed to their medicinal use.—A paper was then read by Mr Malcolin I awrie, on the anatomy of the genera Therypetus and Stimonia, and their relationship to recent. Aradinida. An interesting discussion followed, in which the Preadent, Prof. Howes, Dr. H. Woodward, and others took

Entomological Society, May 6,-Mr Frederick DuCane Entonomorgical Society, May 0.—mat Frederick Dulcane Godman, F. R.S., Preiderick, in the chair.—Dr. D. Sharp exhibited a number of eggs of Dylissus marginalis laid on the sheath of a species of reed, and commented on the manner of their owposition, which he said had been fully described by Dr. Regmbatt —The Rer. A. E. Eaton exhibited a collection of Psychodida from Somersetshire, including six species of Psychoda, eleves species of Personna, and one species of Ulwayra Mr. McLachan commented on the interesting nature of the ethibation—Mr. P. Crowley exhibited a specures of Politic soft batton—Mr. P. Crowley exhibited a specures of Politic soft of another equally handromes species of the same grams from Tongshou, Bermanh, which was said to be undeseribed.—Mr II. Goss, the Secretary, read a letter from Mr. Merrideid, pointing Society on April 1 last, of his views on the effects of temperature in causing variation in Depolopera, was incorrect; he (Mr. Merrifield) had never suggested what maght happen to Temperature in Causiniti, and had expressly sitted that he had eleven species of Personna, and one species of Ulomyia

found a reduction of the temperature below 57° to produce no found a reduction of the temperature below 57" to produce no effect, whereas in Mr Fenn's experiments the temperature must have been below 40"—The Secretary also read a letter which Lord Waisingham had received from 51" Arthur Blackwood, the Secretary of the Post Office, in answer to the memorphy which, on behalf of the Society, had been submitted to the which, on behalf of the Society, had been submitted to the Postmaster-General, saking that small parcels containing scientific specimens might be sent to places abroad at the reduced rates of postage applicable to packets of bond fide trade patterns and samples. The letter intimated that, so far as the English and samples. The letter intimated that, so far as the English Post Office was concerned, scientific specimens sent by sample post to places abroad would not be stopped in future.;

Mathematical Society, May 14.—Prof. Greenhill, F.R.S., President, in the chair.—The following communications were made.—Relations between the divisors of the first a numbers. by Dr. Glaisher, F R.S -Wave motion in a heterogeneous heavy liquid, by Mr. Love.—Disturbance produced by an element of a plane wave of sound or light, by Mr. Basset, F R S—On functions determined from their discontinuities and a certain form of boundary condition, and on a certain Riemann's surface, by Prof W Burnside,—Messrs MacMahon, Larmor, Brynn, and the President took part in the discussions on the

CAMBRIDGE

Philosophical Society, May 4—Prof G H Darwin, President, in the chair.—The following communications were made:—The most general type of electrical awas in delectric media that is consistent with ascertained laws, by Mr. J. yetsem and its radiation, by Mr. J. Larnor.—The theory of discontinuous fluid motion in two dimensions, by Mr. &E. III. Love The paper contains an account of a modification of Mr. Michell's method. It is shown that, in all problems where the constructed whose conformable representation when the constructed whose conformable representation upon a half plane gives rise to the equation of transformation which contains in itself the solution of the problem. The relation, by which the representation is effected can le such problem be destrained by known methods. The whole supple is the reduced to integral years when the contractive of the con obstacles to the motion of fluids are sloved. These include the determination of the mean pressure on a disk with an obstruction in a canal of finite breadth.—On this rotation storped takes, by Mr. C. Chree The subject treating is that of the rotation about their area of this disks whose section of the control of the co

PARIS

Academy of Sciences, May 19.—M. Duchartz in the char — Determination of the constant of abertation, numerical values deduced from two groups of four stars, by M.M. Lewy and Pauexa —On the transit of Mercury, by M. J. Jaassen it is remarked that a conclusive confirmation of the solue origin when at a short datance from the edge of the san, and appeared in the negative projected upon a laumnous background.—On the physical explanation of fluidity, by M. Boustines,—The best of combastion and formation of some chlorine compounds, that for each equivalent of bydrogen replaced by chlorine in a sense of compounds from 20 to 32 calories a disranged. Cl. substituted for II, that disengages about 300 calories—On a double halo with particular of the control grals of equations from derived partials of the second order, by M. E. Goursat —On an elementary method of establishing differential equations of which & functions form the integral, dimensitial equations of which a functions form the integral, by M. F. Caspary.—On a class of complex numbers, by M. Addie Markoff.—Quantitative studies of the chemical action of light; Part in influence of dilution, by M. Georges Lemoine. Experiments with instructer of oxatic acid and ferric chloride taken in equivalent proportions but with different quantities of

water indicate that the chemical action of light upon them increases with the excess of water. The section of heat upon the control of the co :—On the constitutions and heat of formation of bibasic crythritise, by M de Forciand —Thermal disar relative to propionic acid and the propionities of potats and sods, by M. G. Massol. Facial relative to potation and sods, designed and the propionities of potats are done, disengages as much heat as it was prefer and inferior homologues, accue and butyric acids —On the heat of dissolution and the solubility of some organic acids in methyl, ethyl- and proppyl-sicobiols, by M. Timoficew. The results indicate that there is a relation between the molecular solubility and heat of dissolution, the variation of molecular solubility carrying with it a variation, in the opposite sense, of the heat of dissolution.—Action of chlorides of bibasic acids on syanacetic ethers, lation—Action of chlordas of labase and/s on sysaactic ethers, by M. P. T. Muller—On the formation of intries in the earth, by M. P. A. Waller—On the formation of intries in the earth, by M. J. Thoulet—To the genus Royers of the family Elemaces, by Thoulet—On the genus Royers of the family Elemaces, by Genus Harden, and the state of the stat porary with the Ousternary volcanic eruptions of Gravenoure porary with the Quaternary volcanic eruptions of Gravenour (Pay-de-Dôme), by MM Paul Groot and Paul Gauter—Chemical and physiological researches on microbic secretions, transformation and eliumation of organic matter by the pyocyanic bacilius, by MM A. Arnaud and A. Charnn.

CONTENTS. PAGE Medical Research at Edinburgh, IBy J. George Adami The Chemical and Bacteriological Examination of Potable Waters. By P. F. F. Our Book Shelf -Johnstone · "Botany · a Concise Manual for Students of Medicine and Science"—C H W Sim : "Hand-book of the Ferns of Kaffrana"—J Q Sim : "Hand-book of the Ferns of Kanraira — Baker, F.R.S. Deakin : "Rider Papers on Euclid" Lehmann: "Die Krystallanalyse" Letters to the Editor: — The University of London.—Prof. E. Ray Lankeater, F.R.S.; Prof. William Ramsay, F.R.S. Dr Irving Quatermous and the "Audehnungslehre."—Prof. J. Willard Gibbs . The Flying to Pieces of a Whirling Ring, —G, Chree A Comet observed from Sunnse to Noon —Captain A Comet observed from Summe to Account Wm. Ellacott Graphic Duily Record of the Magnetic Declination or Variation of the Compass at Washington — Richardson Clover The Alpine Flora.—J. Lovel Magnetic Anomalies in Russia.—General A. de Tillo The Rejuvenescence of Crystals, By Prof. John W. Notes . . Our Astronomical Column -Our Astronomical Golumn— The Draper Catalogue of Stellar Spectra Solar Observations from January to March 1891 The Constitution of Abstration Ammal Lafe on a Coral Reef. By Dr. S. J Hickson Washington Magnetic Observations, 1886 University and Educational Intelligence Scientific Serials

THURSDAY, JUNE 4, 1891.

THE BRITISH INSTITUTE OF PREVENTIVE MEDICINE.

THE progress of bacterological scenece, and the amount of exact information which it has shed upon the problems of disease during the last fifteen years, have led several of the Governments of the Content and America to establish institutes providing for original research, as well as technical instruction, in preventive medicine

This country, on the other hand, which pioneered sanitary science from its birth, has, strangely enough, been distinctly behindhand in the study of bacteriology (fraught as it is with interest of such vital importance to the health and prosperity of the nation), and of the provision of institutes of the kind which have been established abroad, such as the Pasteur Institute in Paris, the Hygienische Institut in Berlin, Konigsberg, Breslau, Wiesbaden, St Petersburg, Moscow, Odessa, Tiflis, Warsaw, Cracow, Naples, Turin, Rome, Milan, Palermo, Malta, Barcelona, Constantinople, Bucharest, Budapest, Rio Janeiro, New York, Washington, we have no example in the United Kingdom. In these institutions, the study of the morphology, biology, physiology, and chemistry of micro-organisms, whether pathogenic or not, is being actively pushed forward, and a thorough analysis of their subtle influence as causative factors of disease pursued

In this manner the poisons of the following maladies, the effects of which are among the direst evils to humanity, viz. pyæmia, anthrax, erysipelas, septicæmia, glanders, tubercle, diphtheria, &c , have been isolated, and discovered to be micro-organisms which are now known certainly to be the active principle of the virus When we reflect that, for centuries and centuries, the crippling effects of cpidemic and devastating diseases have been only too well known, but attributed to the operation of all manner of causes, er. supernatural agencies, Divine wrath, meteorological and climatic influences, &c, &c, the fact that the real truth concerning the nature of their causes has been ascertained only within the last few years by laboratory research is, in itself, overwhelmingly expressive of the immense value of Bacteriological Institutes and their work

But their value does not stop here. Knowing, as thanks to bacteriology we now do, the origin of these diseases, it may be asked what has the same science done towards stamping them out and preventing their development, or haply arresting their progress should they unfortunately gain access to, and invade, the tissues of the body To express ourselves more plainly, the question might be put in this form, "What has bacteriological science done to discover the antidotes of such poisons?" The answer is, that whereas centuries of clinical observation have done very little indeed-by watching the sick and the employment of drugs-towards the direct arrest of the virus of infective maladies, laboratory work, on the other hand, has already provided us, not merely with many invaluable and additional facts to general science on the subject of immunity, vaccina-

NO. 1127, VOL. 447

tion, a.e. protection before infection, resistance of tissues to invasion by parasitic organisms, &c.; but has given to medical science, what no pharmacopous has ever been able to do—namely, chemical antidores which by their specific action upon their use of diseases alone successfully save human beings as well as the lower animals from death and incapacitating illness.

Of these new methods, perhaps the most noteworthy is Pasteur's treatment of hydrophobia, but others have been already discovered, and are being examined and tested for practical employment in medicine and surgery

À large institute of this kind, however, is not reserved solely for the investigation of the problems of disease—on the contrary, it has a far wider sphere of usefulness Bacterology, which Pasteur showed was the key to the secrets of fermentation, is, of necessity, all-important to many very extensive trades and commercial undertakings. The botanical and biological researches of the Pasteur Institute are thus to a large event utilized by the Fiench manufacturers, as well as by those of other countries, to their great profile.

The particular bearing of this branch of science has never been fully comprehended by the public, who are not aware what an enormous debt of obligation they owc to M. Pasteur, and to the extension of scientific research. which received its impetus from his genius, and which lias resulted in so much direct gain and benefit to the community In like manner, to agriculture, the questions of clianges in soils-such, for example, as nitrification, now known to be due to the action of micro-organisms-are not less important, and indeed essential A Bacteriological Institute, therefore, has in agriculture, quite apart from the subject of diseases of animals, a fertile source of work of the utmost value and assistance to practical men. But, in addition, there has of later years arisen a branch of chemical industry directed towards the synthetic production of numerous substances which prove to be powerful drugs. The knowledge of these is, of course, incomplete and dangerous until thorough experimental investigation of the action of these substances has been made In this country, however, our chemists are precluded, by the harassing legislation under which their coworkers in physiology, pathology, and medicine labour, from pursuing this useful line of research, without great trouble and endless restrictions, although such work is solely directed towards the therapeutic relief of disease and suffering

The chemistry of disinfection offers in itself an extensive field of research which can alone be cultivated in an institution of this kind reserved for bacteriological investigations.

Lastly, in such an institute two subjects of general interest receive special careful attention. These are (i) the technical instruction of medical men, health officers, chemists, and manufacturers, in bacteriology, both in its morphological and biological aspects; and (2) the examination of tissues and substances suspected to be seat or vehicle of infectious diseases and submitted for investigation and report. The functions of a Bacteriological Institute, therefore, clearly involve interests of the bighest national as well as particular or individual import.

Since the formation of the Pasteur Mansion House

Fund, which has provided for the treatment in Pais of many English sufferers from the bites of rabid dogs, some of the members of the Committee of that Fund, as well as of the Mansion House meeting at which at was inaugurated, knowing the importance to the community of having a similar institute in Great Britain determined to make an effort to establish the state.

A survey of the conditions under which hacteriology is practised in Great Britain is sufficient to show at once the pressing need of creating a centre of the kind, since, although several medical schools and Universities have provided for the teaching of bacteriology to a degree suitable for diplomas in public health medicine, and although in the laboratories of the College of Physicians and Surgeons in Edinburgh, and of the conjoint London Colleges, besides those of University College, King's College, and the College of State Medicine, there is room and provision for a certain amount of original work, still it is quite notorious that the majority of original investigators are driven to go to Paris and Berlin, not only on account of the splendid collection of material and freedom of experiment there, but also for lack of sufficient accommodation in the laboratories of the United Kingdom. To remedy this state of things, and to provide an establishment which would greatly assist the medical schools and technical education generally. is therefore the object of the promoters of the British Institute of Preventive Medicine lopment of the scheme has now arrived at a very interesting point, which, as usual in this country, resolves itself into a contest between the friends and enemies of science. The object of the Institute being purely charitable and scientific, it was from the outset necessary to give its constitution a firm basis, in order to obtain the confidence of the public from whom naturally the cost of creating the Institute is to come. It has therefore to be incorporated, and such incorporation can practically only be obtained by permission of the Board of Frade, which grants leave for the registration of such institutes as limited companies, the word limited being omitted, thus insuring the appropriation of the funds for none but purposes identical with the original object for which they were intended The Executive Committee of the British Institute, therefore, made through their solicitors, Messrs Hunter and flaynes, the formal application for such registration to Sir Michael Hicks Beach. the President of the Board of Trade To their surprise Sir Michael refused to register the Institute, and this without assigning in his letter any reason for his refusal. It is, however, understood that he has done so in consequence of his having received petitions from a few bodies of anti-vivisectionists, among whom are to be found as usual certain names, mostly ecclesiastical, of gentlemen whose mientions, however admirable, are dictated by absolute ignorance of the questions which they presume to discuss

We understand (though it is incomprehensible how a funister should have allowed himself to be placed in such a false position) that Sir Michael Hicks Beach alleges privately that by registering the Institute, a portion of the work of which will naturally include experiments on animals, he will be encroaching on the duties of the Home Office, to which department alone, he ever, as a

matter of fact, is intrusted the administration of the utterly incompetent and harasing so called Vivisection Act. Nothing can excuse the confusion of mind or ignorance which is thus displayed by an offician of the Government, for, as is evident to the merest tyro in law, the question of experimental science has nothing whatever to do with the matter submitted to the Board of Trade, That body has only to make sure that the funds of the Institute cannot in the future be misappropriated to any other object. That is all it is asked to do, and that solely in the interests of the oublife.

The official seal of the Board of Trade having thus been given to stamp the Institute with the character designed for it by its promoters—namely, that of a character character and not a commercial undertaking—it would then, of course, be necessary for the Executive Committee to apply to the Home Office for the registration of the Institute as a place where experimental science may be carried on

With this second registration the Board of Trade has nothing whatever to do, and by taking upon himself the duty of considering this part of its constitution, the President has gone out of his way to raise difficulties in the formation by private individuals of a National Institute, which in other more intelligent and far-seeing countries the Governments have hastened to take the initiative in establishing and liberally supporting

It is evident that Sir Michael Hicks Beach has been greatly misinformed on this matter, and we look forward with interest to the result of the representations of a very powerful deputation which we learn is to wait upon him on Friday, June 5, at 11 a m, and which, constituted a sit is of dissinguished men in all branches of science, as well as of those of the general public who are interested in philanthropic sanitary measures, will point out to him the real facts of the case on which he has to adjudicate, the state of the case on which he has to adjudicate, but the support of the sup

It is not difficult, we believe, to read between the lines in such a case as this No beings are more human than Ministers and members of Parliament, or, in fact, all those whose own position or that of their party depends upon popular clamour Such unfortunates listen like Eve with a fatal fascination to the voice of the deceiver. but, with a taste less worthy than hers, the fruit which attracts them is not that of the tree of universal knowledge, but of the ballot-box They have hitherto laboured under the mistaken impression that an energetic and noisy group of agitators, leading in their train a few unscientific quasi-public men, were an important political body, and they consequently sacrifice to their misrepresentations the liberties of science and the good of commerce. The day is coming, or is rather come, when the scientific and cultured world will refuse to submit any longer to such a condition of affairs, and when all its branches, physiologists, agriculturists, chemists, engineers, medical and legal men, will unite in a compact body for the protection of their common interests, and we rather welcome the present difficulty, which has served to bring prominently forward the spirit animating them, and which no administrator will do wisely in failing to recognize.

THE GEOLOGY AND PHYSICAL GEOGRAPHY
OF NORTH SYRIA.

Grundunge der Geologie und physikalischen Geographie von Nord-Syrien Von Dr. Max Blanckenhorn Mit Zwei Karten, &c. (Berlin: Friedlander, 1891)

N this excellent treatise the author presents the reader with a synoptical view of the results of his observations over a region but little known; referring to his previous essays on the geology, palæontology, and petrology of North Syria for fuller details. The region described extends from the northern slopes of the Lebanon to those of the Taurus Mountains, and from the Mediterranean coast to the banks of the Euphrates and the runs of Palmyra, embracing an area of about 45,000 square miles It also includes the whole of the Orontes Valley and the Kurdish Mountains. The mountainous tracts immediately to the south have already been ably described. as regards their physical structure, by Carl Diener, in an essay which was favourably reviewed in NATURE at the time of its publication in 1886, and these observations on the geology of the Lebanon and Hermon have been taken up and extended by Dr. Blanckenhorn to the horders of Asia Minor Still further south, we have the geology of Palestine illustrated and described by Fraas, Larter, Tristram, and the officers of the Palestine Exploration Fund, extending into Edom and Moab and the Sinaitic peninsula; so that, as far as it is possible for travellers to carry out such a work as that of the geological portraiture of the region, we have now the who'e tract from the shores of the Red Sea to the Taurus Mountains very fully described and illustrated. Two maps on a large scale, one showing the topography, the other the geology, accompany the present work. That there should be uncoloured spaces at intervals in the latter was inevitable. and is a proof of the caution exercised by the author in its preparation. The text itself also contains numerous geological sections and illustrations

In comparing the geological structure of the Lebanon, as described by Diener,1 with that of the range between the valley of the Orontes and the coast, called Djebel Ansarige (Nusairier-gebirge), the author observes that the representatives of the Upper Jura and Cenomanian lying at the base of the Lebanon formations are absent in the more northerly tracts, the lowest beds of the series being represented by the "Rudisten-kalk," of probably Turonian age The engraved longitudinal section which the author gives to illustrate this, amongst other physical features, is drawn from the coast at Latakia (Ladikue) over Dj Hassan Erai to the Orontes at Mischalum, and is of much interest as illustrating the general structure of this part of Northern Syria. The valley of the Orontes is shown to be in the line of a great fault, or system of faults, by which the Eocene limestone beds are "thrown down" along the eastern side of the valley against the older Cretaceous strata, which are elevated into the ranges of Dj. el Ansârije and Hassan Erai, capped by the same Eccene limestones which form the bed of the Orontes, but at a difference of relative level of about 1600 feet. On the eastern side of the valley the Eocene strata risc into high ridges, partly by the aid of a N.-S. fault, which is not im-

4 "Libanon, Grundlimen der phys Goographie u. Goologse, v. Mit e'-

probably a continuation of the "great Jordan-Arabah fault," which has produced such remarkable effects in connection with the physical structure of Palestine and Arabia Petrea.\(^1\) The position of this fault seems also to be indicated in the section across the Oriontes at Hamman Shekh has illustration the region of Mons Cassius.

The author gives a graphic description of the gorge of the Orontes in the neighbourhood of the hot springs (Hammam) above the great bend which the river takes from its northerly course towards the west in order to reach the Mediterranean At Dusr esh-Schoghr the river enters a cañon which has been worn down to a depth of 160 metres in beds of Eucene hujestone and marble rich in Nullipores, and amongst the massive Miocene limestone (Grobkalk), while to the left rises the plateau of Di el Koseir, breaking off in successive terraces towards the Orontes Valley, and on the right the crest of 1)1 el 'Ala On leaving this gorge the river enters an extensive alluvial plain, making a inagnificent sweep round to the westward . and in its course through a rocky and broken country bathes the runed walls of Antioch, the once famous capital of Syria-a city which bears so honourable a place in the early history of Christianity

The region of Northern Syria physically divides itself into three distinct regions which are adopted for purposes of description by the author. The first includes the coast ranges, the second, the depression lying to the east of these, including the valleys of the Orontes and the Kara sea and river, the third, the "Hinterland," or interior tracts of North Syria lying to the east of the depression. and including the Khurdish Mountains, we can only here specially notice this last. This region is remarkable for the great tracts of Miocene strata, reposing sometimes on those of Eocene, sometimes on those of Cretaceous, ages of the Palmyrene wilderness and of Anti-Lebanon, and which are in turn largely overspread by great sheets of plateau basalt Of these Miocene strata the plains round Aleppo are chiefly formed. Here they are nearly horizontal, but towards the north they are tilted, and the Eocene and Cretaceous strata again rise to the surface and terminate in the escarpment of Kardalar Dagh. beyond which rises the high plateau of Kawar, and still further towards the north-west the lofty ridge of Giaur Dagh, which reaches an elevation of 1330 metres This latter is formed of Devonian limestone, slate, and grit, which appear to be the fundamental rocks of this part of Syria The plateau of Kawar, which intervenes between the Giaur Dagh and the Kurdish ranges, is formed of gabbro, nonte, schillerfels, and serpentine, of an age intervening between the Upper Chalk and the Eocene The Miocene strata which occupy so extensive a part of Northern Syria were formed, according to the author, under the waters of an arm of the Mediterranean, which extended inwards at the base of DI el-Koseir beyond the Kuweik and the vicinity of Aleppo, bounded by irregular ranges of emergent hills of Eocene and Cretaceous strata The formation consists of basal conglomerates of flint pebbles, passing into calcareous sands, clays, and finally the massive limestone (Grobkalk) already referred to, and has yielded forms of Operculina, Clypeaster, &c., clearly indicating its marine origin. This epoch was remarkable

To Mem on the Physical Geology and Geography of Arabia Petrea, Palestine, &c " (Pales in, Ixiloration Fund), 1885, pp. 103 12

for the display of volcanic energy on a vast scale Great sheets of august lava together with fuff and agglomerate. were erupted during the Miocene epoch, not only in Northern Syria but in the East Jordanic region to the south, and were again renewed in Post-Phocene times It is probable that to volcanic action we must refer the origin of some of the peculiar little lakes of Northern Syria, such as those of Homs and Kara, one occupying the bed of the Orontes, the other that of the Kara, where the ground probably fell in and became filled with water. The Phocene period is represented by both marine and freshwater strata, deposited in bays and depressions along the margins of uprising lands, formed of all the older formations, including those of the Miocene period All of these had been disturbed, upraised, and partially eroded before the deposition of the Phocene strata. In this, as in other physical phenomena of Northern Syria, we are reminded of those of Palestine and Egypt. Throughout all this region the Nummulitic and Cretaceous strata were disturbed and upraised into dry land, and subjected to extensive denudation at the close of the Eocene and again at the close of the Miocene epochs, so that the stratigraphical continuity of these Tertiary formations has been repeatedly broken.

100

It may be worth while, in conclusion, to glance at the points of analogy, as well as of difference, between the physical conditions of Syria and of the region to the south of the Lebanon In Northern Syria, and along the ranges of the Taurus and Anti-Taurus, the fundamental rocks on which are superimposed the great calcareous formations of Cretaceous and Tertiary ages consist of Devonian schists, greywacke, and limestone,1 together with masses of various igneous rock In Southern Palestine and the Sinaitic peninsula, on the other hand, the fundamental rocks consist of granite, gness, various crystalline schists of Archæan age, traversed by innumerable dykes of hornblendic, augitic, and felspathic rock, surmounted at intervals by Lower Carboniferous beds; this is a remark able contrast But a still greater, perhaps, is to be found at the next stage. All along the eastern border of the lordan Valley, south of the Sea of Galilee, extending southwards along the table-land of Moab, Edom, and the Arabah Valley, as well as through the Smaitic peninsula, and into Upper Egypt, the base of the Cretaceous series is represented by the Nubian sandstone, a formation of great persistency, and interesting from an architectural point of view for its extensive use as a building-stone in the great structures of Ancient Egypt; as, for example, in the colossal figures of Amenophis in the plain of Thebes, as also in the temples and sepulchres of Petra. This formation appears to be altogether wanting north of the Lebanon, where, according to Herr Blanckenhorn, the Cretaceous strata of the Turonian stage are the lowest of the series.3 The points of contrast, however, here terminate; for over the whole region from Upper Egypt and the Libyan Desert on the south to the Taurus Mountains on the north, a distance of 1000 miles and beyond, the Cretaceous and Eocene limestones were deposited, and formed part of the floor of the ancient ocean, the original limits of which it is hard to determine with any approach to accuracy.

NO. 1127, VOL. 44

At the close of the Eocene epoch this ocean bed was subjected to powerful movements. Large tracts, including the Libyan Desert and Egypt, Palestine and Syria, were elevated into dry land; while the strata were bent, folded, and faulted along lines ranging generally from north to south To this period is to be referred the production of the great Jordan-Arabah fault, which has now been traced at intervals from the Gulf of Akabah to the valley of the Orontes, a distance of over 350 miles, while the main features, especially the mountains, had the outlines which they now present marked out During the Miocene period, along with a partial re-submergence, volcanic action came into play over a region generally bounded by the Jordanic depression on the west, and extending from the Arabian Desert to the base of the Taurus, and the head waters of the Euphrates. In Northern Syria, extensive sheets of basaltic lava are found west of the Orontes Valley, as well as at Antioch, Aleppo, and other parts At a later period, bordering on the present, fresh erupuons were added. The region we have been considering has its natural boundary towards the north in the Taurus range, where a system of E-W flexures take the place of those of the region to the south, where (as we have seen) the prevalent direction of the flexures is EDWARD HULI meridional.

EUROPEAN BOTANY

Planta Europeæ enumeratio systematica et synonymica plantarum phanorogamicarum in Europa sponte esscentum vel mere inquitinarum Autore K Richter Tomus 1, pp 378 (Leipzig Verlag von Wilhelm Engelmann, 1890)

A / HAT is most wanted in systematic botany at the present time is a general flora of Europe, worked out for the different countries on one uniform plan, with the sub-species and varieties placed in their proper sub ordination under the primary specific types, and the synonyms worked out carefully The number of plants in Europe is about the same as in the United States For these Asa Gray planned a general flora in three volumes, of which the middle one, containing the Gamopetalæ, was published shortly before his death, and the first and third left in a forward state of preparation, Many years ago Mr Bentham planned and carried out, with the assistance of Baron von Mueller, a complete flora of Australia. There are 40 or 50 per cent. more plants in India than in Europe Sir Joseph Hooker's "Flora of British India," containing descriptions and full synonymy of every species, has reached the end of the Dicotyledons, and in the last part the Orchideæ are finished, so that five-sixths of the work is now done. There is, however, no such book in existence as a general descriptive flora of Europe. For Europe the difficulty hes far more in the bibliography than in the plants themselves An enormous number of subordinate forms have been described under specific names, and the number of channels of publication in the way of journals and reports of societies becomes greater and greater every year. Nyman's "Sylloge," published in 1854-55, and his later "Conspectus," have been a great boon to all European workers. Though they do not contain any descriptions, they give a tabular view of the whole European flora,

<sup>As determined by Hamilton Warington Smyth, Tchihatcheff, and others
Probably of Neccoman age
Representing thuse of the chalk-marl of England</sup>

tracing out in detail the geographical distribution of the species; and in the "Conspectors" especially, great pains species; and in the "Conspectors" especially, great pains has been taken to separate the subordinate from the has been taken to separate the subordinate from the not contain any descriptions. It deals with the geometric part of the special pains of the species much more briefly, indicating it within the compass of a single line. Its strong point is bibliography, and it gives under species a list of all the names that have been applied to it by the different authors, with a citation of the book and page great where each name is published, with a note of the date of one of the date of the property of the different authors are the substituted where each name is published, with a note of the date of the page of the property of the page of the page

```
TRITICUM, Section Sitopyros
19. T. monococcum, L., Sp. Pl., edit. 1, p. 86 (1753)
        Syn.: Ægilops Crithodium, Steud, Syn. Gl., 1
                p. 355 (1855)
Crithodium avilopoides, Lk., in Linn, iv
                p 142 (1829).
T. barticum, Bss , Diagn Pl. Or , 1. 13, p 69
                      (1853).
                T pubescens, MB, Casp M, p. 81 (1800)
  Europa austro-orientalis (Ceterum cultum), (Cau-
     casus.)
20. T. sativum, Lam., Enc , 11. p 554 (1786)
    (a) Spelta, L., Sp. Pl., ed. 1, p 86 (1753
Syn T. Zea, Host, Gram., 111 t 29 (1805).
     (b) duoccum, Schrk, Baier. Fl, p 389 (1789).
Syn.: T. anyleum, Ser, Mel Bot, 1 p. 124
                     (1818).
                   atratum, Host, Gram, iv t 8 (1809)
                    Cienfugos, Lag, El, p. 6 (1816)
                T Garlington, Lag, 19 (1977)
T Garlinerianum, Lag, 16
T Spelta, Host, Gram, 111 t. 30 (1805)
T tricoccum, Schuebl., in Flora, 1820,
                      P 458
    (c) sativum, Hack, in Nat Pfizf, 11 2, p 85 (1887)
          a vulgare, Vill, Pl Dauph, 11 p 153 (1787)
Syn. T. astroum, L, Sp. Pl., ed. 1, p 85
                      T cereale, Bmg, En, 11 p. 266 (1846)
T hybernum, L, lc, p 86
           B compactum, Host, Gram , iv t 7 (1809).
             Syn. . 7. velutinum, Schubl, Diss, p. 13
                        (8181)
          y turgidum, L., Sp Pl, ed 1, p 86 (1753)
Syn. T compositum, Linn., f Suppl, p 477
                      (1781)
T Linnæanum, Lag, El, p 6 (1816)
           ð aurum, Desf, Fl Atlant., 1. p. 114 (1798).
             Syn. T. Bauhini, Lag, El, p 6 (1816)
T. brachystachyum, Lag., 1b.
T. cochleare, Lag., 1b.
                      T. fastuosum, Lag., to.
T. hordetforme, Host, Gram., iv. t 5
                        (1809)
                      T. platystachyum, Lag., Ic.
                      T. satirum B, Pers , Syn., i. p 109
                      T. tomentosum, Bayle-Bar., Mon., p. 40
                           (1809)
                      T. villosum, Host, Gram, iv. t 6
                        (1800).
   Cultum in diversis varietatibus.
21. T. polonicum, L., Sp. Pl., ed. 1, p. 86 (1753).
```

Syn.: T. Cevallos, Lag., El., p. 6 (1816).

NO. 1127, VOL. 44]

Cultum.

Of course it is impossible for an author covering such a wide field to work out for himself all the details, and in the critical genera, such as Potamogeton, Festuca, Crocus, Iris, Tulina, and Narcissus, no two authors are ever likely to agree as to which should be classed as primary, which as subordinate types, and which as mere synonyms. The present portion of the work includes only the Gymnosperms and Monocotyledons. The author admits 250 European genera, 1830 species, and 840 sub species. He keeps up the oldest specific name published under any genus, not, as is usual in England, the name first published under the genus in which the plant is now placed. I find that a considerable number of books and papers published in England have not been taken into account . for instance, Maw's magnificent monograph of the genus Crocus, C. B. Clarke's monograph of the European species of Eleocharis in the Journal of Botany, 1887, p 267, and Arthur Bennett's work on Potamogeton, as summarized in the last edition of Hooker's "Student's Flora" The book has cost great care and pains, and will be found very useful by all who work at European botany I G BAKER.

OUR BOOK SHELF

The Missouri Botanical Garden 8vo, with several Maps and Engravings (Printed for private circulation by the Managers, 1891.)

111. Missouri Botanical Carden is situated at the city of \$1 Louis, and was founded by the late Henry Shaw. He was born at Sheffield in the year 1800, and emigrated to Canada, with his father at the age of eighteen, and a small isolated French trading post. He established himself in business as a dealer in cultery, made a fortune of 25,000 dollars by the time he was forty years of age, and then retuced from business. In 1840 he visited tourin the Old World. In 1851 he wisted Chatsworth, and particularly admired the garden and conservatories. This led him to entertain the idea of forming a large garden at home. One of the best American betasists, Dr self-with the control of the control of the control of the lost American botanists, Dr self-with the control of the control of the control of the lost and conservations. Dr belp and advice. In 1857 he opened a correspondence with \$ir William Hooker. He engaged from the Royal Botanic Carden in Regent's Park Mr. James Gurney to superintend the Carrying out of his plans. He ded in structed partly within and partly outside the limits of the toy of \$i\$. Louis, to be keep up as a Botanic Carden open

to the public, containing a museum and library.

On the recommendation of Dr Asa Gray, Mr. William
Trelease, who was then Professor of Botany in the Wisconsin University at Madison, was appointed in 1885
Director of the Garden, a post which he still holds, and
porosision was made for the establishment of a school
or strength of the work of the public of the control of the cont

The present volume contains a biographical sketch of the founder of the Gardens, a copy of his will, of the Act that was passed to enable him to convey the land to the trustees, because the control of the Control of

preached in Christ Church Cathedral on May 18, 1890, by the Bishop of Missouri. The book is illustrated by plans of the garden, a large number of views of the museums and other buildings, including Mr Shaw's house and a fine statue of Humboldt.

Everything is now in fall working order, and we have just received from Prof Trelease a capital synopsis of the American species of the difficult genus Epilobium, containing full botanical descriptions and figures of all the species. The herbarium now contains about 20,000 mounted sheets of howering plants and ferns, also a large collection of Fungi and other Cryptogamas.

Géologie Principes-Explication de l'Époque Quaternaire sans Hypothèses. Par H. Hermite. Pp 145. (Neuchatel. 1801)

On taking up this little book the geological reader is at once struck by the words "sans Hypotheses" in the title A volume on Pleistocene geology free from hypotheses would seem to him to usher in a new era in geology, and would be most heartily welcomed by him. The title of the present work, however, is insleading, the book is almost entirely devoted to theoretical explanations of purely hypothetical facts We have not space to notice in detail the various subjects of which the author treats. but as an example of his method we may point to his
"Origine des Pluies Quaternaires" (p 30) In this
section he accepts the hypothetical Quaternary "Pluvial Period "-which, by the way, seems to have been characterized by a singularly poor aquatic fauna and flora—and he then accounts for the supposed excessive rainfall during Tertiary and Quaternary time by the amount of vapour thrown out by volcanoes, adding that the small rainfall of the Secondary periods is accounted for by the absence of volcanic action during those periods! Then we meet with our old acquaintance the former excess of carbonic acid in the air and its influence on the ancient climate of the polar regions—possibly correct, but certainly hypothetical Further on, speaking of the origin of the continental platform at a depth of 200 metres, the author states that this feature results from the raising of the general level of the sea from the melting of the Quaternary ice, and from this hypothetical raising he arrives at the result that the mass of the Quaternary ice corresponded to the total mass of the sea now lying above the level of the continental platform Another speculation relates to the breaking through of the Indian Ocean across Siberia to the Polar seas, thus causing a milder climate, and accounting also for the parallel roads of Glen Roy and the terraces in Norway and Greenland We cannot pretend to follow the reasoning, but it is all somehow connected with the author's theory "qu'à une diminution de la densité des iners correspond un abaissement de leur surface "

Webster's International Puttomary of the English Language Revised and Enlarged under the Supervision of Noah Porter, D.D., L.L.D. (London George Bell and Sons, Springfield, Mass. U.S.A. G and C Merriam and Co.)

WERSTER's Dictionary is so well known on both sides of the Atlantic that it is unnecessary to do much more than note the appearance of the present edition. The work was published originally in 1828, after which it was steadily improved in successive issues. It has now been revised to horoughly, and with the aid of so many competent scholars, that for popular use it can hardly fail to present the control of the present of the properties of the present of the field in the preface to the English edition it is stated that no pains have been spared to make this part of the book "as prefice as possible in both text and illustration." The

definitions in particular branches of science have been revised by much men as Prof. H. A. Newton and Prof. E. S. Dana—names which are a sufficient guarantee for ke way in which the task has been accomplished. In the department of etymology, Prof. E. S. Sheldon, of Harvard University, has carefully dealt with the results presented in the last edution, bringing them into accord with the philological decase of the present day. The pictorial illustrations are numerous, and well adapted to the purposes for which they are inserted.

Elementary Chemistry, for Beginners By W. Jerome Harrison, F.G.S (London Blackie and Son, 1890)

THE volume of 144 yeages constat of an expansion of the author's notes of lessions prepared for teaching children from nine to thirteen years of age according to the outlines given in the education code. The information is conveyed in familiar language, and each chapter closes with a series of questions which har well reached the contract of the co

Examination of Water for Samtary and Technical Purposes By Henry Lellmann, M D, Ph D, and William Heam, M A Second Edition (London Kegan Paul, Trench, Frubner and Co, Ltd., 1891)

This fact that a second edition has been called for only two years after the issue of the first, shows that this excellent hand book has been very generally appreciated the authors have revised the work and made many additions to it chiefly of processes that have recently grown importance. Among the principle of the property of the first edition are now expanded into a chapter of threten pages entitled, "Biological Examinations" A table of culture phenomena of some of the more important microbes is given. But concerning this matter the authors state that "until pathogenic microbes are more interest than the control of the state of the concerning the state that it is not problem of the determination of the sanitary and technical value of water supplies"

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to con-sepond worth the worters of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications!

The University of London

I no not with 10 entruse in the least Prof. Lunkester, whalshe sattement in your last inner, with which I entirely sprese, but I desue to point out that unless some energetic scion is taken very soon we are likely to be faither than very from the ideal which be has in view—namely, the establishment of a strong prefessional University in Condo. The only scheme at present in the field is that put forward by the Councils of University and King's Colleges in the proposed others for an Albert University.

This scheme has never met with the cordial support of a large section at least of the teaching staff of University College, and for section at least of the teaching staff of University College, and for the very obvoors reason that to des not constitute a professorial University, but creates a new examining body on which the two Colleges will be, in the heigining at any rate, largely represented The Albert University Charter would create a second Victoria University in Loudous Colleges will be, the Colleges will be, and the colleges of the University in Loudous was to facted. Illuviersity the Victoria in Loudou, but they seem to forget that this petitiogram excuse for a University—a scheme drinked by burseucentz rather than academic minds—sinth colly scheme in the field, and that, further, the Lord Presented of the Council has determined to hear by counsel, on an early day in June, what can be said for and against this scheme. It is further removed that the bear removed against this scheme It is lutther rumoured that the Burlington House Senate intends, after its recent discomfiture, to remain absolutely neutral. The danger, then, that we shall have a repetition in London of the difficulties of Manchester is a very repetition in London of the difficulties of Manchester is a very immediate one. Let no pront our exactly the anomalies of the Albert scheme. In the way independent of the Albert scheme. In the way independent of the Albert scheme in the property of the Albert scheme in the property of the Albert scheme in the Albert scheme So long as there is competition between the Colleges, so long as So long as there is competition between the Colleges, so long as they possess a double staff competing at every turn with each other for students' fees, this is unlikely to be remedied. Prof. Lankester speaks of a union of King's and University, and talks about their combined resources. The fusion of these two talks about their combined resources. The fusion of these two Colleges would certainly be the first stage to a true professorial University in London, but there is nothing in the Albert charter to bring this about it unites the two College, not for teaching but for examining purposes. But what is still worse, while these two Colleges will remain autonomous, the Albert charter proposes to admit any further autonomous bodies, the teaching of which can be shown to have reached a certain academic standard hese bodies will not be absorbed, but their independent staffs will be represented on the Faculties and Senate. Here we have will be represented on the Faculties and Senate. Here we have in fact the University of London over signin,—at first composed almost entirely of the two Colleges, afterwards, embracing all sorts and conditions of institutions in I ondon, and ultimately open to every isolated text book reader in the universe. It open to every solded text book reader in the universe. It cannot be therefore too strongly insisted upon that the Albert charter, if granted, will not call into existence a professional University, but federate a group, and an ever-wedning group, of competing institutions for the purposes of commentation. If it shed for a time any additional liaster on the technique staffs of the two Colleges—which I am much inclined to doubt—it will not achieve, what most of us have at heart, the establishment not achieve, what most of us have at heart, the establishment in Loudon, at any rate in the germ, of a great Unwersity in the Southsh or German sense. A University, on the scale we hope of the Royal College of Steines, and of the Cortal Institute without the least difficulty. With the death or transference of exiting teachers, whose premistry unterests would have of course of the contract of the which will only impede its ultimate realization, ought to meet with strenuous opposition from those who believe that a great professorial University must sooner or later be established in

The difficulty as to the granting of medical degrees will for long be the stumbling block of any scheme, but the true way to long be the stumbing block of any senteme, but the true way to surmount it seems to be that suggested by Prof Lankester—namely, the complete divorce of the climical teaching at University and King's Colleges from the selence teaching, and the establishment of separate chincal schools at the existing College bospatials. ment of separate chincal schools at the existing College bospassas on precisely the same footing with regard to the University as the other medical schools. The preliminary science teaching at the various medical schools might then be safely intrusted to University readers, who might continue to be, as they now largely

"Riementary teaching in many branches might for local convenience be still carried on at several centres.

NO. 1127, VOL. 44

are, penpatetic. These readers would naturally belong to the science faculty of the new University, and if largely paid by students' fees might be trusted to safeguard the "prehiumary scientific interests" of the medical schools. It seems to me, therefore, that some vigorous effort ought to be made to obtain the modification of the Albert University scheme in the sense indicated by the following proposals -

PROPOSALS IN TO TEACHING UNIVERSITY

No scheme for the constitution of a teaching University in

London will be satisfactory which does not I Place the appointment of the teaching staff, as well as the control of laboratories, libraries, and buildings, in the hands of a single executive body, hereinafter spoken of as the new University Senate, or of bodies, such as Faculties or boards

University Senate, or of bodies, such as Faculities or bards of study, to which it may delegate its powers

2. Confer on the new University Senate the power of graning degrees in all Faculities, including that of Medicine

3. Give to the teaching staff an immediate representation of one-third, and an ultimate representation of at least one-half, on

the new University Senate

the new University Schate
These conditions would probably be best fulfilled by
4. The immediate fusion of the Councils of University and
King's Colleges, and the Council or Governing Body of any
other institution doing work of admittedly academic character. in London, which may be willing that its laboratories and University Senate.

University Senate,
[This would remove any ground from the objection that the
two Colleges are claiming powers which they are not willing to
share with the Royal College of Science or the Central Institute
It provides for these latter coming into the scheme on the same

The granting of a Charter to a body consisting of these combined Councils together with representatives of the teachers in the combined institutions

The constitution of the new University Senate in the following manner -

A Immediate constitution-

(1) The fused Councils of King's and University Colleges or their representatives thurd of the total number

(2) The Councils of other academic bodies in London willing to be absorbed, or then representatives (3) Representatives of the teachers to the extent of one-

B. Illumate constitution-

(1) University professors, either as 1/50 facto members

arreasing processors, either as 1950 leave members or as representatives of the body of professors
 (2) Representatives of the Faculties (i e of the readers and professors of each Faculty)
 (3) Co-optitude members, not to be selected from the

teaching staff And possibly,

(4) Representatives of bodies willing to endow professorships in the new University, or to hand over to ships in the new University, or to hand over to the control of the University existing professor ships or lecture-hips, $\epsilon_{\mathcal{S}}$ (a) the Corporation of the City and the Mercers Companya trustees of Sir Thomas Gresham's estate, (b) the Ilaus of Court—provided these bodies are willing to attach the Gresham Lecturers and the Reader ships instituted by the Council of Legal Pducation ships instituted by the Council of Legal Pducation

ships instituted by the Council of Logar Physicians to the new University

(5) Representatives of the Medical Schools and Royal Colleges of Physicians and Sirgeons other than those selected by the Medical Faculty. This would only be a matter for consideration when the power to grant medical degrees became actual

7 The transition from the immediate to the ultimate con-stitution of the new University Senate in the following menner -

(a) By not filling up vacancies among the members contri-buted to the new Senate by the existing Coll ge Councils as such occur

(b) By the increase of professorial members and representa-tives of the Faculties.

8. The suspension of the power to grant medical degrees until such time as the Senste of the new University shall have satisfied the Lord President of the Council that an agreement has been reached with the Royal Colleges and the chief Loudon Medical Schools as to the terms on which medical degrees shall be granted

of granted 9 Providing, on the repeal of the Acts of Incorporation of University and King's Colleges which would accompany the granting of the new Charter, special regulations for the control of certain portions of the endowments or of certain branches of

of certain portions of the endowments of of certain branches of the College technic, which it may not seem possible or advisable at present to hand over without special conditions to the manage-ter of the control of the control of the control of the control portion); at King College 10. Paying due regard to the pecuniary interests of examing techner (many of whom depend entirely upon students fees) in the appointment of future University professor or readers. In might be willing to surrender the title of College professor, that of University reader, but not creating the occupants of charm in any of the existing Colleges in the feet professor, that new University.

In this meresketch I have said nothing as to how faculties and boards of study much the constituted or as to how the University should grant degrees, for these seem to me "academic "prob-lems, a problema to bethrashed out by the University is elliwhen it is once moroprosited "Objection will be taken to much of the above by many individuals, but I believe it forestandows the the above by many individuals, but I Delieve it ioresnatures the direction in which the only wheme at present under discussion must be modified if it is to lead to the ultimate extablishment of a great teaching. University in London, and not to a mere organization of teachers for examination purposes. KARL PhARSON,

It seems to me that the force of the approxime of Ponds Landener and Romany in low seeds. Nat USE (May 8), pp. 76, 78), to far as they harmonize with each other, would have to be deatited, if the man object of a University were to foster that premiture specialism, which, under the acholiship system, has recommended and the seeds of the control of th of the great scientific societies makes one only too familiar. The example of this has been well set by at least one of the great metropolitan day schools — The fatal weakness of the arguments referred to is that they spnore, as no University ought to do, the claims of general education. If the advancement of sclentific research is really desired by University and King's colleges, all they have to do is to institute on their own account a diploma of the nature of the Associateship of the Royal School of Mines or College of Science, and make the training for it so or names or college or Science, and make the training for its ogod and thorough that the pussessors of such a diploma shall be such a diedectation in those "commercial" quarters to which Prof. Ramssay appeals as a over of final sulfurinty, that they shall drive such creatures as 18.5c 's out of the field. Special brampower, highly developed, it no doubt a splended thing in its power, mighty developed, is no doubt a precided thing in way, and recognition of it in the field of science is fully provided for in the B Sc. honours, and in the ultimate D Sc degree, but, in considering the terms on which a degree should be given, general education and culture cannot be left out of account. In ermany something of the sort is guaranteed by the examinatio which have to be passed on leaving the gymnasium (or high school) before students proceed to the University to specialize; in England it has been found necessary to institute the matriculain augustion it has been sound necessary of markets the matricular tool examination. That need, however, is no longer so imperative as it was, and for my own part 1 see no real objection to the "leaving certificate" of the Oxford and Cambridge Exthe "leaving cerificate" of the Usford and Cambridge Ex-amining Board being accepted in lien thereof, for I spak of what I know, when I say that this entries with it a guarantee of so much education and culture as the Marticulation Examination does, and often a great deal more. I would only supulate that a should include one modern language and one branch of

scence Prof. Ramsay has over-ridden his horse, by the emphatic preference he gives to a German degree. He is a comparatively young man, but some of us (who are not yet quite senie), can remember the time when the facilities for obtaining the German Ph.D degree were such (they are such to this day in America), that the degree became a by-word and a represseh, and still

NO. 1127, VOL. 44]

carries with it suspsesses altogether disadvantageous to those who have taken the genuine degree in Germany. This is nirely who have taken the genuine degree in Germany. This is not construct that the second of the second of the degree of the degree of the degree of the degree of M.A., which in the eyes of the vulgur is upposed to represent higher melletuchal attainments that the M.A., which is the degree of M.A. which is the eyes of the vulgur is supposed to represent higher melletuchal attainments that the M.A., can we expect greater virtue in a small and brand new Univer-sity struggling to "make both ends meet"? Were any further illustration required of the way things would be likely to drift Were any further with small and independent degree granting corporations, we might find it in the readiness with which the authorities of King's College threw over Latin two years ago in the mercantile deconcept hrew over Latin two years ago in the mercantile de-partment of their school (then in a state of depression), at the mere bidding of the Chambers of Commerce, although its retunion had been advocated by two leading scientific men. The really inspiring motive of this agitation is, I tblink, issuitely kep in the background

Wellington College, Berks, June 1

ONE of the taunts most frequently levelled at the London University—or "Burlington Gardeas," to use Prof. Lankseite", favourie expression—by certain professor of University Cellege for a first contract the contract of the University that this should not be done been privously told that there was a "text understanding" at the foundation of the University that this should not be done But I'red, Ray Lankester goes far beyond the assection of a foundation of the property of the same of the private of the same of the sa gether to see, for it was the expressed intention of the founders of the University that its powers and privileges should be the same as those of the Universities of Oxford and Cambridge. Testimony as to this pledge may be found in the evidence given before the recent Commission. The late Dr Carpenter's view of this matter was stated by Mr Dickins in his communication of this matter was stated by Bar Lickins in his Communication to NATURE. Convectation has, years ago, voted in favour of the establishment of University Professorships and Lecture-ships, though I of not in the least believe that the graduates would sanction any proposal involving that the University should prepare candidates for its examinations, or compite with the ordinary work of the Professors in University College and other simular instatutions. Whether research is or in not carried. on successfully at University College is a matter on which I express no opinion. But, however this may be, it should be remembered that the students of this College have become only a small fraction of the candidates for London degrees. It would a small fraction of the candidates for London degrees. It would be, it seems to me, in the public interest that the University should make provision for the encouragement and reward of content for the cancellar for the content for the carecta and a power to extend the boundaries of knowledge. That the University has only one solitary Professor and e.g. believe, in great measure to the narrowmanded and university professor of University College, and to the fear lest some andown in also did chance to be diverted to the University.

processory of contents of contents of the test of the

College students being compolled to meet elsewhere instead of in the College on account of there being something of a religious character connected with their meetings, while there are facts of a different character in the battory of King's College which may be easily remembered. That a feferial University constanting of institutions so dissuming would work harmonously? I very much care but little, except on ourseaff and the care but little, except on ourseaff and before the care to be little, except on ourseaff and before when the care of doubt. Probably the graduates of the existing University would care but little, except on general pablic grounds, about Uni-versity and King's Colleges having power to grant degrees, if as taken for that of the University of London. A syet the Victoria University is not a conspicuous success, and the I ondon Uni-versity examinations are still held at Owen College

versity examinations are still held at Owens College With the views set forth by Mr. Thiselion Dyer I should be disposed in great measure to agree, though there are some points on which I should have liked to make some remarks, but I fear, if I did so, I should trespass too far on your space. London, May 29

THOMAS TYLER. London, May 29

THOSE who have taken part in the interesting discussion on the University of London, in your columns, have all viewed the subject from the academic standpoint. Would it not be well to consider it also from another point of view, viz that of the educational needs of London? Frof Ramsy contends bounds of Knowledge. It is usurly more accurate to say that it University, under the conditions that now easily, has two main functions—the one the extension of the bounds of knowledge. by research, and the other the wide diffusion of that knowledge by research, and the other the wide diffusion of that knowledge. The purpose of such diffusion should be to afford, as far as possible, to every individual the opportunity of obtaining such a training as would qualify him or her to take part in the development of sonic branch of knowledge, or at any rate to follow with appreciation and interest the advance made by others

It needs no argument to show that it would be for the advantage of research, and for the well-being of the community, that real University training should be as widespread as possible Ability and bent for some special study may frequently not be developed until somewhat late in life, after a husiness career has been begun. There is scarcely a branch of science that does has been begun Inere is careely a branch of science coardoors not owe much to investigators whose researches were carried on during bours spared from some bread-winning occupation. The late Prof. John Morris was in early life a chemist in the Borough, Dr. James Croll was for years the janitor of the Borough, Dr. James Croll was for years the janior or the Andersonian University, Glagow, even in the very number of NATURE containing Mr. Dyer's letter, the cass of M. Rouauli, one of the poincers in the geology of Britanay, is mentioned, who did his early work while carrying on the business of hardenser. A University training would have been of inestimable value to such students as these (and there are hundreds of such. with capacity for good work, scattered over London and the country), but no provision is made for them in our existing

Surely the important question therefore is, What kind of University would discharge most effectively for London the duty of providing for the needs of every class of students? Fhe University should clearly recognize all organized teaching of University should be supported to the control of the c verity hould clearly recognize all organized teaching of University rank, whether given within the walls of a specified College or not. One of the most urgent neerly of London is a coordinating head for all its multinons higher effectational species. The only University that will really adequately meet verified to the control of the c

The new teaching University for London should have as its The new teaching University for London should have as its accredited professor and lectures the staffs of University and King's Colleges, the Koyal College of Science, the various medical schools, and any other inclutions of equal mak, and in metropoles at convenient central. It would be the property of the extension of the principle admitted into the drift scheme for the reconstitution of the University of London, via. that of requiring from every University teacher a syllabus of his course of teaching, and further, by making such syllabus the beast of the semiliation, to incorporate all the work done by the accredited

teachers of the University into its curriculum for degrees. This would make it nosmble to one the university career to would make it nosmble to be under the control of the university career to come of study in three or four years, evening students would take nine or ten, and the curriculum could without serious difficulty be modified to meet the conditions.

R D. ROBERTS

I WOULD ask whether it is quite fair to assume that, because Convocation has rejected the Charter proposed for the Uni-versity of London, it therefore follows that that body is out of sympathy with the attempts that are being made to establish a "real University," whatever that may mean Is it not possible that a large proportion of those adverse votes were recorded because there were elements in the scheme which were felt to be impracticable or open to serious objection? At all events, I feel sure that there are many who would refrain from regarding the vote as being an expression on the main issue.

the vote as being an expression on the innin issue.

The views so well put forward by Frof Ray Lankester as to
the undesirability of establishing what he terms federal Unversities fally enlist our sympathies, but are we not saling very
near the wind in the suggestion that University and King's
Colleges and "other institutions" should be incorporated on University lines?

I say, by all means avoid centralization and beware of the "never-ending Committees and schedules of such clumsily-organized Universities" But what of value is then left that University College does not already possess? Would the appropriate definition and allotwent of degrees of all shades and appropriate definition and another of the work and influence of Graham, Sanderson, Sharpey, Foster, Williamson, and Prof I ankester himself, or have added to the benefit they have conferred upon University College? One does not surely regard the granting of degrees as an important element in the German the granting of degrees as an important element in the German University: 1st distinguished professors are ont Berlin men or Straschurg men—they are pupils of Liebig, of Wohler, of Bansen, and the like, and its students are not regarded as graduates of Herdelberg or Giessen, but in like manner as pupils of so and so And University (Ollege 1s, I lake it, insuch more nearly in function a German University now than ever it is likely to be as a fideral University. I verily believe that such is the taste of the so called properly ordered English mind for is the taste of the so called properly ordered English mind for schemes, plans, and organizations, that a governing body, even though largely composed of the most uncrystallizable elements, would shortly he found carefully hedging itself round (and the students) with that beautiful machinery which Prof. Lankester so heartily detests Prof Ramsay's association of "examina tion on the brain" with the London University undergraduate I fear does the said undergraduate an injustice, if it is meant to differentiate him from his fellows of the "real Universities"

differentiate him from his fellows of the "real Universities". The men who regard the College Calendar with its traditional quistions as their web. means, and whose only other study is the disopercasses of the examiner, are shouldess, and their name is legion. If I could think they were confined to the "Barlington Gardens University", I, for one, would vote against the alteration of one jot or stitle of the present organization, if only lest they might be disturbed from their resting place there May 30.

Quaternions and the Ausdehnungslehre

Quaterniona and the Ausdehnungslehre Proor Ginis's second long letter was ordently written before he could have read my reply to the first. This is infortunite, in the question now raised. Of course that question is naturally confined to the invention of methods, for it would be preposterous to compare Gramman with Insuffice as an analyst confined to the invention of methods, for it would be the English, and have consulted once more the authorities there from the end of the method withing which I should have liked to after. There is much, of course, which I should have liked to after There is much, of course, which I should have liked to after There is much, of course, which I should have liked to after the course of the the Ausdehmungilehrs been asked of me, I should certainly have declined to undertake it. Since 1860, when I ceased to be a Professor of Mathematics, I have paid no special attention to general systems of Sets, Matrices, or Algebras, and without much further knowledge I should not attempt to write in any detail about such subjects. I may, however, call attention to the facts which follow, for they appear to be decisive of the question now raised Cauchy (Comptes Rendus, 10/1/53) claimed quaternia as a special case of his "clefs algebriques." Grassmann, in turn, (Compter Rendut, 17/4/54; and Crelle, 49) declared Cauchy's methods to be precisely those of the Ausdehndeclared Cauchy's methods to be precisely those of the Austehnungslehre But Hamilton (Lecturer, Pref. p (64), foot note) says of the clefs algebriques (and therefore, on Grassmanns' come showing, of the methods of the Austehnungslehre) that they are "incitated in that theory of Siris in algebra.

appounced by the in 1835... of which SETS I have always considered the QUAIRRNIONS... to be merely a farticular CASE."

a fartreuter CAE." On the Description regarded and little has no five for the control of the con But all this has nothing to do with Quatermons, regarded as liere, as anyone interested in the matter can readily consult the

In regard to Matrices, I do not think I have ever claimed anything for Hamilton beyond the «parable », and the symbolic cubic (or biquadratic, as the case may be) with its linear factors, and these I still assert to be exclusively his. My own work in this direction has been confined to Hamilton's ϕ , with its square-

tina unecomi nas ocen contact to stammion s synthesis or coop, in a spitamon to viter an attention to the coop, in a spitamon to viter an attention of the coop of

The Spinning Ring

I CANNOI suppose that the mathematicians are all in error, but venture modestly to ask what are the assumed conditions under which a girdle round the earth at the equator would be subject to strain. If the surface of our globe at the equator were continuous and level land, about 30,000,000 of persons more than 1000 to a mile-standing at equal distances and joining hands, would form a girdle without any strain, or the girdle might be formed of separate pieces of wire placed end to end in close contact, which, if afterwards soldered, would form a girdle, without strain

without strain and the strain of the strain

4 Serieants' Inn. Fleet Street, April 30

BISHOP COURTENAY'S questions may perhaps be clearly answered as follows The centrifugal force of a free spinning answered as joilows I not Centinugal sorte of a tree spinning hoop has to be balanced by its perspheral tension; but this having a large tangential and a small radal component, acts at a datadvantage, and may have to be very big to balance over a moderate centrifugal force. The larger the boop the more marked lat the magnitude of the tangential component as compared with the radal or effective component; so that a hoop 8000 miller in dameter could not rotate even once a day without processing the component of the component of the component of the compared with the radal or effective component; so that a hoop 8000 miller in dameter could not rotate even once a day without processing the component of the componen tearing itself asunder.

NO. 1127, VOL. 44]

An actual girdle round the earth is not dependent on pert-pheral tension for balancing its centrifugal force, since it is subject to an overpowering centripetal force due to the earth's

The statement made by Mr. Herschel on p. 514, vol. zliii., involved not a 20-fold stress but a 20-fold speed, which means a 400-fold stress. OLIVER I. LODGE

The Use of Startling Colours and Noises.

Last January a friend showed me a smew (Mergus albellus) shot on the Dee, near Chester, the crop of which he had found to be full of young flat-fish. He called attention to the dazzling whiteness of the bird's breast, and suggested that it must frighten the fish, and so be a disadvantage to it A little consideration showed that the effect would be precisely the reverse. As long as the flat-fish remains at rest, its colouring assimilates so closely to the sand on which it lies, and with which it partly covers to the sand on which it lies, and with which it partly covers itself, that it would not be easily each by the sime. But if, startled by the white object flashing down on it from above, it moves, it is seen at once, and of course captured. Anybody who has ever collected small insects, such as beetles, will admit the truth of this at once

the truth of this at once The same effect is probably produced by the hooting or screaming of owly when hunting at night. A mouse, which would be invisible even to the sharp eyes of an owl when motionless, would be seen at once if startled into motion by the sudden "short" of the bird, whose noiseless flight had brought it unperceived into close proximity.

it unperceived into close proximity.

Perhaps these suggestions may serve to explain other apparent difficulties in the way of natural selection

The brown owl hoots throughout the winter here, so that it cannot be a sexual call

ALERLO O WALKER. Nantyglyn, Colwyn Bay, May 25,

The Formation of Language

I PERCEIVE that my note on the evolution of speech in the case of one of my children has excited some interest and called out communications both to myself and to you; hat I must trespass again on your kindness to explain that what I considered noteworthy at that case was not the invention of words, which noteworthy in that case was not the invention of words, which is not of rare occurrence, but the, to me, far more important phenomenon of the evolution of the habit of speech through the three stages, so distinctly marked in this case—of simulation, the faculty we share with the monkey, and which does not imply the possession of the idea, of invention of symbols, which indicates the birth of the power of conception, and perhaps the formation of what Max Muller calls "concepts," and the the formation of what Max Muller calls "concepts," and the perception by the young mind of a community of interest and intelligence, and, finally, the faculty of learning from others ideas already formed, or what must be considered the germ of science and it was the clear demarciation of the three states which interested me more than the mere invention of words which interested me more than the mere invention or worst And this interest is the greater as the case appears to illustrate a law that the development of the individual follows the lines of the universal, so that the child but repeats, in a very much abbreviated sequence, what humanity had gone through as a whole of the control of th to the establishing of the law, than to publish an isolated phenomenon. W. I. STILLMAN. Rome, May 8.

Cordylophora lacuatris.

IT will be interesting to soologists to know that Prof. Weldon recently found very sugar quantities of Corelipher a Generative to the Prof. Weldon P salt tide has but once been known so high up these rivers.

JOHN BIDGOOD.

7 Richmond Terrace, Gateshead-on-Tyne.

ON SOME POINTS IN THE EARLY HISTORY OF ASTRONOMY.

ıν

FROM what has been stated it is not too much to assume that the Egyptians observed the sun on the borison. This being so, the chances are that at first they would observe the stars on the horizon too, both stars probable by the very careful way in which early astronomers defined the various conditions under which a star can rise or set, always, be it well remembered, in relation to the sun. They spoke of a star as rising or setting

	on Rising.	Morning ,	True or cosmic	Sun rising.		
Star at eastern horizon			Apparent or heliacal.	Sun not yet risen, but depressed below horizon sufficiently to enable the star to be seen.		
	Actioning.	Evening	True or achronic	Sun setting		
				Sun just set, and depressed below horizon sufficiently to enable the star to be seen.		
	o. Setting	Evening	True or cosmic.	Sun setting.		
Sinr at western horizon.			True or cosmic. Apparent or hebacal	Sun set, and depressed below horizon sufficiently to enable the star to be seen		
that at western Horizon,			True or achronic	Sun rising.		
		Morning.	True or achronic Apparent or heliacal	Sun not yet risen, but depressed below horizon sufficiently to enable the star to be seen.		

It is Ideler's opinion that, in Ptolemy's time, in the case of stars of the first magnitude, for helical triangs and settings, if the star and sun were on the same horizon a depression of 1". Was taken, if on opposite horizons a depression of 7". For stars of the second magnitude, these values were 1,4" and 8\$." But it temples the second that the support of 1". It is the support of 1" and 1"

Before we begin to consider the question of stars at all, we must be able to describe them to speak of them in a way that shall define exactly what star conting to its constellation on its equatorial or celiptic co-ordinates, but all these means of reference were unknown to the earthest observers; still we may assume that the Egyptians could define some of the stars in some fashion, and it is evident that we here approach a matter of the very highest importance for our subject.

So far, as we have been dealing with the sun and the observations of the sun at rising and setting, we have taken for granted that the amplitude of the sun at the estituced does not change: the amplitude of 5 at Thebes, so the state of the sun at the state of the sun at the state of the sun at the state of the state

In the last lecture we considered what were called the ecliptic and the equatorial co-ordinates. The ecliptic was the plane in which the earth moves round the sun, and 90° from that plane we had the pole of the heavens;

eclipite north and south up to the pole of the heaven, and celestal longitude we recknod along the plane of the eclipite from the first point of Anes. We had also declination recknode from the equation of the earth prolonged to the stars, and right ascension recknode along the equation from the first point of Aries. The pole of the heavens then we must regard as fixed, but the pole of the earth is not tracel, but slowly moves round it. In consequence of that movement there is a change of declination in a star's plate.

The cosmic rising meant that the star rose, and the

cosmic setting meant that the star set, at the same moment

as the sun—that is, that along the eastern horizon we should see the star rising at the moment of sunrise, or along the western horizon a star setting at the

moment of the sun setting. The achronical rising is different from the cosmic in this respect—that we have

the star rising when the sun is setting and setting when the sun is rising. Finally we have the heliacal

rising and setting, that is taken to be that the star

appeared in the morning a little in advance of the surrise, or set at twilight a little later than the sun. The

following table from Biot 1 should make matters quite

Going back to the tables, we find that the amplitude of a body rising or setting at Thebes or anywhere else depends upon its declination, so that if from any cause the declination of a star changes, its amplitude must change at any particular place

That is the first point where we meet with difficulty, because if the amplitude changes it is the same as saying that the place of star rising or star setting changes, that is, a star which rose in the east in a certain amplitude this year will change its amplitude at some future time. The real cause of the precession of the stars hes in

the fact that the earth is not a sphere, its equatoral diameter being longer than its polar diameter, so that there is a mass of matter round the equator in excess of what we should get if the earth were sphereal. Suppose what we should get if the earth were sphereal. Suppose differently presented to the sun, one part being nature than the other, the neater part being attracted more forcibly. If we take the point where there is the greatest attraction, and draw a line to the least, we can show that the case stands in this way: that the surs pail the case stands in this way: that the surs pail the sun and the point in a direction parallel to the line joining the centre of the sun and the centre of the line joining the centre of the sun and the centre of the line joining the centre of the sun and the centre of the line joining the centre of the sun and the centre of the line joining the centre of the sun and the centre of the line joining the centre of the sun and the centre of the line joining the centre of the sun and the centre of the line joining the centre of the sun and the centre of the line joining the centre of the sun and the centre of

Continued from p. 60. NO. 1127, VOL. 44] ring, and another force at right angles to it. The question is, what will that force at right angles do?

Here we have a model showing the rotation of the

Here we have a model showing the rotation of the surf ton its ass, and the concurrent revolution of the sur round the earth once a year. To represent the surf round the earth saw, instead of retaining its direction to the same point as it did before, is now jesscribing a circle round the pole of the heavens. It is now a recognized principle that there is, so to speak, a wobble of theeathrd axis round the pole of the heavens in consequence of the axis round the pole of the heavens in consequence of the ring being greater than on the part of the equatorial ring being greater than on the part of the equatorial ring the properties of the part of the surface of t

by the moon, the moon being so very much nearer to us.
In consequence, then, of this lumbsolar precision we have a variation of the points of intersection of the planes of the earth's equator and of the ecliptic; in consequence of that we have a difference in the constellations in which he am is at the time of the solitores and at the equinoxes; and, will more important, we have another difference, in the constellation of the state.

change from century to century

108

Having thus become acquainted with the physical cause of that movement of the earth's axis which gives rise to what is called the precession of the equinoxes, we have next to inquire into some of the results of the movement. The change of direction of the axis in space has a cycle of something between 25,000 and 26,000 years
As it is a question of the change of the position of the
celestial equator, or rather of the pole of the celestial equator, amongst the stars in relation to the pole of the heavens, of course the declinations of stars will be changed to a very considerable extent, indeed, we easily see that the declination of a star can vary by twice the amount of the obliquity, or 47°, so that a star at one time may have zero declination—that is, it may lie on the equator—and at another it may have a declination of 47° N or 5 Or, again, a star may be the pole star at one particular time, and at another it will be distant from the pole no less than 47° Although we get this enormous change in one equatorial co-ordinate, there would from this cause alone be practically no change with regard to the corresponding co-ordinate—that is to say, the position of the star with reference to the earth's movement round the sun movement takes place quite independently of the direction of the axis, so that while we get this tremendous swirl in declination, the latitudes of the stars or their distance from the ecliptic north or south will scarcely change at all.

Among the most important results of these movements dependent upon precession we have the vanous changes in the pole star from period to period, due to the various positions occupied by the pole of the earth's equator. We be pole stars will change, for a pole star is merely the star near the pole of the equator for the time being. At present, as we all know, the pole star is in the constellar on Ursa Minor. During the last 15,000 years the pole from the pole of the equator of the time to the pole of the pole star is in the constellar which is equal to the obliquity of the ecliptic; so that about 10,000 or 12,000 years ago the pole star was no longer the little star in Ursa Minor that we all know, but the big star Vega in the consellation Lyra. Of course the star in Ursa Minor that we all know, but the big star Vega in the consellation Lyra. Of course the star in Ursa Minor that we all know, but the big star Vega in the consellation Lyra. Of course the star in Ursa Minor that we all those, but the last presence the pole star was practically the same as

Associated with this change of the pole star there is another matter of the highest importance to be considered, because as the axis is being drawn round in this way, the point of intersection of the two fundamental planes, the plane of the earth's rotation and the plane of the earth's

revolution, will be liable to change, and the period will be the same, about 25,000 years. Where these two planes cut each other we have the equanous, because the intersection of the planes defines for us the vernal and the section of the planes defines for us the vernal and the between these points we have the solitices. In a period of 25,000 years the star which is nearest to the equinox will return to it, and that which is nearest the solitice will return to it. During the period there will be a constant change of stars marking the equinoxes and the solitices.

Flune 4, 1891

can be a star marking the equinoses and the southers and the southers are some anong the spoints in the sun syearly path there so the same of the spoints in the sun syearly path the sun of the spoints of the sun of the s

Very fortunately we have such a means of calculation, and it has been employed very extensively at different periods, chiefly by M. Biot in France, and quite recently by German sarromeres, in calculating the positions of the stars from the present time to a period of 2000 years cacwary, the listude, longitude, right sacension, declination, and the relation of the stars to an equinox, a solitice, or a pole, as frank as 2000 years B.C. Since we have the planes of the equator and ecliptic cutting each other at different points in consequence of the cause which I should be such as 2000 years B.C. Since we have the planes of the equator and a variable equator different points. In consequence of the cause which I so not fixed, so that we have not only a variable equator the planes of the country of the planes of the cepture tiself is not fixed, so that we have not only a variable equator these calculations is to determine the has been done these calculations is to determine the relations and the results of these variations.

A simpler, though not so accurate a method, consists in the use of the precessional globe, ent of which I have here. In this we have two fixed points at the part of the precessional globe, one of which I have here. In this we have two fixed points at the part of the precession of t

If we wish to investigate the position of things, say soop years ago, we bring the globe back again to its bearings, and then adjust the screws into the holes. We will be the second of the second of the proper for the period. We will be the second of the proper for the period. We will be the second of the period of the period of the that time all we have to do is to paint a line on the globe in some water-colour, by holding a camel's harp pendid at the east or wear point. That line represents the equator Soop years ago. Having that line, of course the lineture of the period of the period of the period of the period culture of the period of the period of the period of the period of the second of the period versal equinox. Or if we take that part of the ecliptic which is nearest to the north pole and therefore the declination of which is greatest, uz. 23½ N. we have there the position of the sun at the summer solute, and 23½ S. will give us the position of the sun at the winter solutice. So by means of such a globe as this it is quite possible to determine the position of the equator among the stars, and note those four important points in the solar year, the two equinoxes and the two solstices. I have taken a period of 8000 years, but I might just as easily have taken a greater or a smaller number By means of this arrangement, therefore, we can determine within a very small degree of error without any laborious calculations, the distance of any body north or south of the equator, s.e. its declination

The positions thus found, say, for intervals of 1000 years, may be plotted on a curve, so that we can, with a considerable amount of accuracy, obtain the star's place for any year Thus the globe may be made to tell us that in the year 1000 AD the declination of Fomalhaut that in the year 1000 A.D the declination of Formalination was 35°S, in 1000 B.C it was 42°, in 2000 it was about 44°, in 4000 it was a little over 42° again, but in 6000 B.C to about 22°

The curve of Capella falls from 41°N at 0 A.D., to 10°

at 6000 BC., so we have in these 6000 years in the case of this star run through a large part of that variation to

which I drew your attention

Here is the curve of Sirius. This star, in o AD, had a declination of 24° S; but 5000 years BC it had a declination of something like 31½° In Sirius we have the curve plotted from the computations of Mr. Hind, who has kindly placed them at my disposal other computations supplied by him. I have ascertained that the globe is a very good guide indeed within something like 1" of declination, always assuming that the star has no great proper motion. Considering the difficulty of the determination of amplitudes in the case of buildings, it is clear that the globe may be utilized with advantage, at all events in the first instance.

Now that we are familiar with the effect of the precession of the equinoxes in changing the amplitudes of the rising and setting places of stars, we can return to the consideration of the temples So far, we have considered those built in relation to the sun, in the case of which body there is, of course, no precessional movement, so that a temple once oriented to the sun would remain so for a long time. After some thousands of years, however, the change in the obliquity of the ecliptic would produce a small change in the amplitude of a solstice

Suppose we take, as before, that region of the earth's surface in the Nile valley with a latitude of about 26' N The temples there built to observe the sun will have an east and west aspect true if they have anything to do with the sun at the equinoxes, and will have an amplitude of about 26° N. or S. if they have anything to

do with the sun at the solstices

The archæologists who have endeavoured to investigate the orientations of these buildings have found that they the orientations of these buildings have round that they practically face in all directions; the statement is that their arrangement is principally characterized by the want of it; they have been put down higheldy-puggledy, there has been a symmetrophobia, mitigated by a general desire that the temple should face the Nile. This wew desire that the temples should face the Nile. It his view may be the true one, if stars were not observed as well as the sun; for at Thebes, if any temple have an amplitude more than 26° N or S. of E. or W, it cannot by any possibility have been used, as we have seen the temples at Karnak might have been used, for observations of the sun; for since the maximum declination of the sun is almost 24½° (it is at present only 23½°), represented by an amplitude of 27°, no temple oriented in a direction more northerly or more southerly could get the light of the sun along its axis.

Let us see, then, if the builders of them had any idea in their minds consected with astronomy. If they had, we may conclude that there was some purpose of utility to be served, as the solar temples were used undoubtedly, among other thungs, for determining the exact length of the solar year. When we come to examine these non-solar temples, the first question is, Do they resemble in construction the solar ones? Are the horizontal telescope conditions retained? The evidence on this point is overwhelming. Take the temple of Denderal it points a baye enflated of it. In many others construct would in the conditions of the solar points of the sola to be served, as the solar temples were used undoubtedly have enfiladed it. In many others pointing well to the north or south, the axis extends from the exterior pylon to the Sanctuary or Naos which is found always at the closed end of the temple We have the same number of pylons, gradually getting narrower and narrower as we get to the Naos, and in some there is a gradual rise from the first exterior pylon to the part which represents the section of the Naos, so that a beam of horizontal light coming through the central door might enter it over the heads of the people flocking into the temple,

and pass uninterruptedly into the Sanctuary.

In these, as at Karnak, you see we have this collimating
axis We have the other end of the temple blocked, we have these various diaphragms or pylons, so that, practically, there is absolutely no question of principle of construction involved in this temple that was not involved

in the great solar temple at Karnak itself.

We made out that in the case of the temples devoted to sun-worship, and to the determination of the length of the year, there was very good reason why all these attempts should be made to cut off the light, by all these diaphragms and stone ceilings, because, among other things, one wanted to find the precise point occupied by the sunbeam on the two or three days near the winter and summer solstices in order to determine the exact inoment of the solstice

of the solutice
But if a temple is not intended to observe the sun,
why these diaphragms? Why keep the astronomer,
good reason indeed, because the truer the orientation
of the temple to the star, and the greater the darkness
he was kept in, the sooner would he catch the rising
star. In the first place, the diaphragms would indicate
the true line that he had to watch, he would not have to search for the star which he expected; and obviously the more he was kept in the dark the sooner could he see the

The next point that I have to make is that in the case of some of these temples which are not directed to the sun we get exactly the same amplitudes in different To show this clearly it will be convenient to bring together the chief temples near Karnak and those having the same amplitudes elsewhere We can do this by laying down along a circle the different

amplitudes to which these various temples point amplitudes to which linese various temples point 10 begin with, I will draw your attention to those temples which we have already discussed with an amplitude of 27 or 26, at Abydos, Thebes, and Karnak. Next we have non-solar amplitudes at Karnak and Thebes, associated with temples having the same amplitude at Denderah, with temptes having the same amplitude at Denderah, Abydos, and other places. We have-the majority of the non-solar temptes removed just as far as they can be in amplitude from the solar ones, for the reason that they are as nearly as possible at night angles to them. We have temples with the same amplitude. high north and high south, in different places—temples, therefore, which could not have been built with reference to the sun; just as we have at different places temples with the same amplitudes which could have been used for solar purposes.

In connection with the possible astronomical uses of these temples, I find that when one of these temples has been built, the horizon has always been very carefully left open; there has always been a possibility of vision along the collimating axis prolonged. Lines of sphinxes have been broken to ensure this; sit Medinet Abou, on the opposite side of the river to Karnak, we have outside this great temple a model of a Syrain fort. If we prolong the line of the temple from the middle of the National Conference of the Syrain fort. If we prolong the line of the temple from the middle of the National Conference of the Syrain fort. If we prolong the line of the Conference of the National Conference of

It may be said that that cannot be true of Karnak, because we see on the general plan that one of the temples, with an azimuth of 7; Nn, had its collimating axis blocked by numerous buildings. That is true; but when one comes to examine into the date of these buildings, its found that they are all very jate, whereas there is evidence that the temple was one of the first, if not the very first, of the temples built at libeds built at libeds.

Markette spent a long time in examining the temple of Karaak. His idea is that the part of the temple near the Sanctuary represents the first part of the building, and at that time the great temple of Karnak-enormous though it is now—was so small and entirely out of the existence might have been entirely neglected. There was first a square court like the court of the Tabernacle, and very shortly after that a very laboured system of pylons was introduced to restrict the light. The next stage shows the Sanctuary thrown lasted was from the Stage shows the Sanctuary thrown lasted was from the by the addition of pylons, until finally, after two or three extensions, the length of the temple was quadrupled So that the proof is positive that at first the horizon of the temple of Mast was left prefetcy clear. Why it was

subsequently blocked I shall suggest afterwards. The next point to be noticed is that there is in very many cases a rectangular arrangement, so that if the sun were observed in one temple and a star in the other, there would be a difference of 60° between the position of the sun and the position of the star at that moment. This sun and the position of the star at that moment. This that the star is t

If we look at Denderah we find that we have there a large temple inclosed in a square temenos wall, the sides of which are parallel to the sides of the temple, and also little temples a temple to the sides of the temple.

a little temple at right angles to the principal one.

It is hardly far to asy that a rectangular arrangement, repeated in different localities, is accidental, it is one which is used to some extent in our modern observatories.

The perpetual recurrence of these rectangular temples shows, I think, that in all the pairs of temples which are

thus represented, there was some definite view in the minds of those who built them.

Another point is that, when we get some temples pointing a certain number of degrees south of east, we get other temples pointing the same number of degrees south of east, we get other temples pointing the same number of degrees south of west, so that some temples may have been used to observe risings and others settings of stars in the same declination. It is then natural of course to conclude that these temples were arranged to observe the rising and setting of the same stars.

J. NORMAN LOCKYER.
(To be continued)

BOTANICAL ENTERPRISE IN THE WEST

WE have several times had occasion to mention the mission of Mr. D. Morris, the Assistant Director of the Royal Gardens, Kew, to the West Indies, in connection with the extension and organization of

botamical stations in the British colonies of that re-gion; and the Kew Bulletin for May and June, as we have already noted, contains his report thereon. It is a lengthy and interesting document, from which we propose to extract some particulars that may be welcome to our readers, and serve to put on record the reviving enterprise in the development of the natural resources of that part of the Empire. The primary object of Mr Morira's visit was to settle the practical details of a scheme for establishing and administering a number of smaller botanical gardens in connection with the larger gardens of Trinidad and Iamaica. The mainlarger gardens of Trinidad and Jamaica. purpose of these gardens is to raise plants of economic value, suitable for cultivation in the various islands, " and to do all that is possible to encourage a diversified system of cultural industries, and thus relieve the planters from the one or two staples to which they have hitherto confined their attention"; but they will also be made, as far as possible, pleasant places of public resoit Mr. Morris met with a hearty reception everywhere, and great interest was manifested in the work by the negro freeholders, in some of the islands, as well as the English colonists. The men in charge of these experimental stations, as they may be called, rather than botanical gardens, are they may be called, rather than bolanical gardens, are mostly trained men from Kew, and Kew is the centre from which plants and seeds of economic plants likely to succeed in the West Indies are distributed. Mr. Morris left, Kew in November last, and returned home Morris left Kew in November last, and returned home at the end of February. Advantage was taken of his outward journey to send by the same ship, under his innuiediate supervision, a number of Wardian caese filled with Gambier plants. Gambier, it may be added, is the name of a substance used in tanning, obtained from Cincerta Gambier, knob, and the plants had been raised at Kew from seeds received from the Shattas Settlements, several attempts to introduce plants from the East having failed How the plants were successfully carried to the West Indies we learn from the following passage in the

report "Owing to the cold weather, the cases containing the plants on board the Atrato were placed below in the main saloon. There was very little direct light in the daytime, but the question of warmth was for the moment of more importance than that of light. It was also hoped that they could be placed on deck in a day or two at the most The weather during the whole of the first week, however, continued very cold, and it was impossible to expose the plants on deck. Under these circumstances it was fortunate that the electric light, with which every part of the ship was supplied, was available to try an experiment of some interest. Although the plants received very little light during the day, they had a good supply of the electric light during the night, and the plants in the cases more fully exposed to the electric light were afterwards found to be in a much better condition than the others. It is well known that plants will thrive under the influence of artificial light, but in this instance there was so little direct light available during the day, that the plants had to depend almost entirely on the light they pants had to depend amost entirely on the light they received at high. The Gambier plants are particularly sensitive as regards a diminution of light. During the prevalence of fogs at Kew they have been known to drop their leaves within a day or two, and to remain bare during the rest of the winter. This may have been, in some measure, also due to the injurious influence of the

some measure, also due to the injurious imitence or use for fitted. One fitted in the fitted in the

becoming too cold for them on deck, and then the more electric light they have the better.

Out of the whole consignment to the various islands only ten plants succumbed; but this was due to an oversight in carrying the case on to Trinidad and La

sight in carrying the case on to Trinidad and La Gusyra, and having to bring it back again to 5t. Vincent, thereby causing a delay in landing of ten days. Mr. Morris wistled successively Antigua, Dominica, Monsterrat, St Kitts, Anguilla, Tortola, Santa Lucia, St. Vincent, Grenada, Barbados, and Jamanca, being present at the opening of the Exhibition at the last-named sistand. Everywhere the Governors and other officials seem to have done their utmost, both personally and indirectly, to assist Mr. Morris in fulfilling the object and thurrectly, to assist the most are many the mission. Established gardens were inspected, sites for new gardens selected, means discussed, and addresses delivered, from which it is confidently hoped that substantial advantages to the cultural industries may

Mr Morris's Report, which may be obtained for the sum of fourpence, is a valuable and interesting account of the present condition and future prospects of planting in the various islands, and should be in the hands of all concerned. We conclude this notice with an extract from a description of the lime plantations in Montserrat, "where the immense golden heaps of ripe fruit were alone worth a journey to the West Indies."

The West Indian lime (Citrus medica, var acida) appears to be a thin-skinned local variety, little known outside the West India Islands It yields juice of a singularly pure acid flavour, and it deserves to be much better known in this country in the fresh state for making 'lemon' beverages, as well as for general use in cookery The enterprise of the Montserrat Company extends to other things besides limes Nevertheless, from limes alone it is possible to produce a variety of articles more or less valuable. The limes themselves are exported as gathered, or they are preserved in salt water, and shipped in a pickled state for consumption in certain parts of the United States. Lime-juice, obtained by compression, is exported either raw or in a concentrated state. This latter is obtained by evaporating the raw juice in botlers until it is reduced to about one-twelfth of the original bulk, when it is ready for export as a dark, viscid substance like molasses. This is used for the preparation of commercial curic acid From the rind of the fruit, by a process known as 'ecuelling,' which consists of gently rubbing the fruit on rounded projections arranged inside a brass basin, a very fine essence of limes is obtained by distilling the raw lime-juice a spirit is obtained known as otl of limes

NOTES

THE deputation which is to submit to Sir Michael Hicks Beach to-morrow a statement of the facts relating to the pro posed British Institute of Preventive Medicine, will be large, influential, and thoroughly representative of the various depart ments of science. It is expected that the following gentlemen will speak . Sir Joseph Lister, the Duke of Westminster, Sir Henry Roscoe, Prof. Dewar, Mr Haldane, M P. O C. and Prof Ray Lankester. A letter from Prof. Huxley will be read.

THE list of those selected for Birthday Honours includes Dr. Archibald Geikie, on whom the honour of knighthood has been conferred, and Mr Robert Giffen, who has been made C B

In the course of an investigation, part of which has already been communicated to the Royal Society, Prof Roberts-Austen has discovered the most brilliantly coloured alloy as yet known It has a rich purple colour, and bright ruby tints are obtained when light is reflected from one surface of the alloy to another. It contains about 78 per cent. of gold, the rest of the alloy being aluminium. The constants of the aluminium gold series of alloys are now being examined, and will shortly be published

On Tuesday last, at Oxford, Convocation sanctioned the expenditure of very considerable sums of money in order to provide increased accommodation for the medical and science schools. The Lecturer in Human Anatomy, Mr. Arthur Thomson, estimated that the immediate wants of his department necessitated the expenditure of £7000 With this sum might be provided a laboratory, which would include dissectingrooms, a museum, working rooms, and a lecture theatre of a temporary character, and has now proved itself utterly madequate for the requirements of his class The number of students now studying in Oxford with the intention of passing the M B examination is 67 As illustrating the growth of the class, and the interest taken in this school, it may be mentioned that in 188¢ the lecturer's class consisted of only three members The Deputy Professor of Physiology (Dr Ray Lankester) required the more modest sum of £2000 in order to supply the deficiencies in the department of Morphology With this sum two laboratories could be provided, one 40 x 20 feet, and the other 30 × 20 feet Meanwhile the departments of Lithnology and Goology find themselves cramped for space at the University Museum, and Convocation has granted the sum of \$1300 to provide rooms for the use of the Curator and the servants of the Museum, and increased accommodation for teaching The Hope Professor of Zoology (Prof Westwood) needed only the expenditure of £350 upon additions and improvements in his department at the University Muse im The expenditure of these various sums, amounting in the aggre gate to nearly £11,000, will place the School of Medicine and the related sciences in a satisfactory position, and the University of Oxford is to be congratulated on its appreciation of the importance of these departments, and the liberality with which it maintains them

THE Gold Medal of the Linnean Society has this year been awarded to Dr. Edouard Bornet, of Paris, for distinguished researches in botany. His earliest publications related to the structure and life history of Fungi and Lichens, but his name is best known for the important researches in which, with his friend M Thurst, he has been for some years engaged, on the life histories of Algre, and for his valuable contributions on this subject in the "Liudes Phycologiques," and the "Notes Alcologiques," with their beautiful illustrations

At a meeting of the Ashmolean Society, Oxford, on Tune 1, there was an interesting discussion on a paper, by Mr Romanes, on Weismann's theories of heredity, in which Prof. Lankester and Mr Poulton took prominent parts

M Doutton, Denion-trator in Botany at the Museum of Natural History, Paris, has undertaken a scientific expedition to Madagascar.

MR NORMAN LOCKYER, F R S, has undertaken to give a lecture at Bedford College (for Ladies), Haker Street, on Wednesday next, at 4 o'clock, "On Natural Philosophy for Artists"

We regret to have to record the death of Sir John Hawkshaw. FRS He died on Tuesday last at his town residence, Belgrave Mansions, in his Sist year. The greatest of his many engineering feats was the construction of the Severn Tunnel He was President of the Institution of Civil Engineers in 1862-63, and of the British Association at its Bristol meeting in 1875 He received the honour of knighthood in 1873

SEVEN years have elapsed since the first International Ornithological Congress took place in Vienna, under the presidency of the late Crown Prince Rudolph. Eagland was on that occasion, as a correspondent wrote at the time, "conspicuous by her absence," and at the second Congress, which has just been held at Budapest, Great Britain was but feebly represented. It is difficult to understand this unwillingness of Englishmen to visit an International Congress. Our countrymen are always sure of a hospitable reception, the interchange of ideas with foreign colleagues is pleasant and profitable, the personal friendships which result are of permanent value, and in the case of Museum officials the relations established with the Museums of the Continent invariably result in mutual benefit The great question which all coologists can discuss is that of nomenclature This year a prelumnary skirmish took place at Frankfort, where the annual meeting of the German Oralthological Society was held on May 11 and 12, under the presidency of Prof. Wilhelm Blasius, of Brunswick The Senckenburg Museum at Frankfort had been closed for four years, and had been opened to the public only four days before the arrival of the visitors. Prof. Noll, the well-known editor of the Zoologischer Garten, welcomed the German Ornithological Society in a few well-chosen words, and then followed the discussion on zoological nomenclature, which occupied the best part of two days of hard work. The proposals of the Committee appointed to examine into and report on the rules of zoological nomenclature were fully discussed, and were adopted, though, by the courtesy of the members, Mr. Bowdler Sharpe, and Mr Buttikofer, of the Leyden Museum, were allowed to state their objections to some of the propositions. The members and guests of the Society were conducted round the Museum by Prof Noll and Dr Hartert, and great satisfaction was expressed at the excellent condition in which Prof Ruppell's types were found to be The ornithological collection has been carefully catalogued by Dr Hartert, and his recently-published catalogue of the collection is an admirable piece of work. At the conclusion of the meeting, an adjournment took place to the Loological Gardens, where the visitors were hospitably entertained by the Director, who personally conducted them round the Gardens From Frankfort a detachment of members and guests proceeded to Vienna and thence to Budapest, to attend the meeting of the Ornithological Congress

MESSAE MACVILLAN have nearly really for publication "A listory of Human Marriage," by Dr. Rabward Westermarks, Lecturer on Sociology at the University of Finland, Hebitegiors in an introduction pote the work is commended to the attention of students by Dr. A R. Wilkee, who expresses a high opinion of the learning and insight displayed by the author. Dr. Westermark differs widely in many respects from the opinions to the complex of the strength of the property of the strength of marriane.

In the House of Commons on Friday last, there was an interesting debate on the Ordnance Survey Mr. Roby, who introduced the subject, had much to say as to the unsatisfactory rate at which the Survey is proceeding, and Sir George Campbell effectively contrasted the work done in England with that done in other countries In India, he said, the surveys were incomparably ahead of those in the United Kingdom; he was often surprised at the perfection of the surveys even of those portions of that vast country only reached by sportsmen or explorers "In his own country he found nothing of the kind. There, in one of the most cultivated and civilized places in the world, they had nothing but the old survey It was a disgrace to the country that we should not have decent maps." Mr. Chaplin, under whose department the Ordnance Survey has been placed, said what he could in defence of existing arrangements, but was not disposed to deny that there was much solid ground for complaint. He promised that his influence should be used to secure reform in various directions

THE University College Biological Society has arranged for an excursion to Sheerness on Saturday, June 6 The excursion NO. I127, VOL. 44

will leave Victoria at 10 a.m., and the time at Sheerness will be spent either in dredging or shore work. The party will be accompanied by Prof. Weldon.

THE Eastern papers report that an expedition has, by order of the Straits Government, commenced work on the frontier between Burmsh and the Malay Peninsula. Its operations will be chiefly confined to Pahano It is placed under the charge of Mr. Ridley. Director of Gardens and Forests in the Straits Settlements, accompanied by Mr. William Davison, Curator of the Raffles Library, Singapore, and Lieutenant Kelsall, R.A. The funds available for the expedition are 2000 dollars voted from the Straits Treasury The object is to ascend the highest mountain in Pahang, incidentally noting all that can be learned about the physical features and the flora and fauna of the country The expedition was to go by steamer to Pekan, thence up atream to Kuala Lipis, thence northerly up the Tembelinis and Sat rivers I laving ascended the latter river so far as it may be navigable for small canoes, the expedition willstrike through forest and jungle, estimated to extend for sixty miles, till they emerge at Gunong Tahan, which is said to be about 8000 feet high Ascending this mountain, and crossing what is called Cameron's plateau, they will then ascend Gunong Stam, a mountain the height of which has been estimated to be as much as 14,000 feet Having completed this ascent, they will return by the same route, the estimated period of absence from Singapore being between two and three months. The party were to take with them three Tamil hunters and collectors attached to Mr Davison's Museum staff, and three Malays of the Gardens and Forests Department.

At the meeting of the French Meteorological Society on May 5, a discussion by M Millot of fifty years' observations at Nancy was presented. The temperature and rainfall values were divided into two periods, viz. 1841-79 and 1880-90 These averages showed that the mean temperature had considerably decreased since the winter of 1879-80, and that the amount of rainfall had increased, the climate showed a tendency to become more continental M Teisserenc de Bort communicated the results of his inquiries re pecting a destructive tornado which visited the town of Dreux on August 18 last At 10's 5m pm , Paris time, a sharp clap of thunder occurred, followed by heavy rain and hail for about a minute. and five minutes later the tornado broke over the town with a noise resembling that of an express train, making a furrow in the ground, and in less than a minute tiles were flying about, trees uprooted, and several houses destroyed. After a short course the effects of the tornado ceased, and it appeared to rise to the upper strata of air, but descended again with equal violence near Epone about 60 kilometres distant, the rate of translation being about 29 miles an hour. The action of the electricity seemed to be of an unusual nature, although much damage was done by it, no metallic object was fused, but only traces of fusion could be found in bad conducting bodles. Among other incidents an iron bedstead was dismounted, without trace of fusion. The paper was illustrated by several photographs, showing the damage done in various parts of the

DB J HANN has communicated another important treatise to the Vienna Academy, entitled "Studes on the Conditions of All-pressure and Temperature on the Summit of the Sonabilet, of All-pressure and Temperature on the Summit of the Sonabilet, of Sonabilet, of Sonabilet, of Sonabilet, of Sonabilet, of Sonabilet, of Sonabilet, which is based upon four years' and analyzolones." The work is based upon four years' however, the sonabilet of severations, and a sidvided line teight sections, viz.—(1) An investigation of the general meteorological conditions under which the maxima and minima of air pressure occur on the Sonabilet. The anomalies of pressure are more marked above than below, and are increased by the accompanying emperature

THE 4. 18017

anomaly, which is relatively high in barometric maxima, and relatively low in barometric minima. (2) The range of temperature during the passage of a barometric wave. This is, at least during the winter season, the opposite to that at the lower level (3) Temperature with varying amount of cloud in winter. The highest temperature coincides with the least cloud, upon the summit, and conversely on the plain. The clear winter days on the Sonnblick have relatively high temperature with great dryness, and these conditions are characteristic of the harometric maxima. (4) Monthly maxima and minima of temperature. The former mostly occur during barometric maxima, and the latter when the high pressure lies in the west or north, and while a barometric minimum exists over Italy or the Adriatic (5) Temperature and air pressure on the Sonnblick during barometric minima over Central Europe, especially over the Eastern Alps The mean temperature at the height of 6650 feet during the passage of barometric minima was below the normal, amounting on an average to 2° 5 F. during the winter season. The use of deviations of pressure and temperature in answering many questions of atmospheric physics is here discussed, (6) Vertical distribution of temperature, and mean temperature in a column of air of a kilometres in height. The calculations have been made separately for each winter. (7) Preliminary indications respecting the relations of the winddirections to barometric maxima and minima A considerable divergence (45°-90°) is shown from the directions as observed below, and the results confirm the conclusions drawn from cloud observations by 1 A Broun and others (8) Refutation of some objections against the conclusiveness of temperature observations on mountain summits, and general remarks on cyclones and anticyclones. The author points out that recent mountain temperature observations and other facts are opposed to the explanation of barometric maxima and minima in extratropical regions by purely thermic considerations.

THE relations of weather and disease have been recently investigated by Herr Magelsson, of Leipzig, who, having formerly called attention to the nature of certain "waves" which recur in the variations of temperature (distinguishing waves of about 12 days, 50 days, and 18 to 20 years duration), now traces a connection of these with diseases and mortality. The yearwaves especially show this connection, the mortality (in our latitudes) varying with the winter temperature The least mortality (relatively) is at the middle part of the temperature periods. The injurious influence of hest is dominant in the more southern latitudes (such as Vienna), while cold begins to act beneficially In northern places, mild winters prove injurious where several very mild winters come in succession (eg Stockbolm in 1871-74) The most favourable conditions seem to be an alternation of moderately cold and moderately mild winters. Too much importance, the author thinks, has been attached to relative humidity. He further offers proof that infectious disease is even more dependent on weather than disease of the respiratory organs, or arlsing from chill

THE value of systematic observation of snow is now being recognized in meteorology, and in Russia observations were commenced in January last year at 428 stations in the Furopean portion of the Empire, 21 in the Asiatic, and 55 in the Caucasus At first it was simply reported daily whether there was a continuous snow covering about the station or not. But last winter the inquiry has been extended to the depth and general behaviour of the snow. Thus it is expected that in a few years, some valuable climatological material will have been accumulated at St. Petersburg. The report of Herr Berg on the snow in the early months of 1890, in European Russia (Report. fur Metcor), contains a map showing the southern and western limit of the continuous snow-covering for the first and fifteenth of each of the months January to April. In the west the snow extended stea My till the beginning of March, the limit being then close to the Baltic. In the south-east, there was steady advance till F 1 ruary, and as far as the coast of the Casman. In the south, the advance was fluctuating, there being a maximum in the middle of January, and the middle of February, both reaching to the Black Sea coast. The retirement of the snow-limit began in the south and south east in the middle of February, in the west about half a month later. The general direction was north-east. On April 15 the limit passed through Onega on the White Sea. Wetlura. and Kathermenburg

By the first of May, all European Russia was free from snow

Herr Berg describes the weather accompanying the disappearance of the snow, and traces its causation

A DIRECT observation of hail in the process of formation is recorded in the Naturw Rundschau. In the afternoon of a squally day Prof. Tosetti, looking eastwards through the window of a house (in Northern Italy) which, with two others, enclosed a court, saw the rain which streamed down from the roof to the right, cangot by a very cold wind from the north, and driven back and up in thick drops Suddenly a south wind blew, and the drops, tossed about in all directions, were transformed into see halls. When the south wind ceased, this transformation also ceased, but whenever the south wind recurred, the phenomenon was reproduced, and this was observed three or four times in ten minutes

Engineering of the 20th ult. states that an extraordinary accident had occurred at the London Paris Telephone Office in the Palais de la Bourse One of the employes, a gentleman named Weller, wished to communicate with the London office on a matter of service. He had already rung up the English officials, and, the bell having sounded in reply, took up the receivers and put them to his cars, when he suddenly sustained a shock of electricity of such severity that it threw him stappering backwards against the door of the telephone cabinet, which, not having been properly fastened, flew open, with the result that he was thrown heavily to the ground. It appears from inquiries that similar accidents, although less serious, have occurred at this telephone office on several previous occasions. The officials attribute them to lightning striking the wire, either at San Gatte, where the submarine cable ends, or at the terminus of the land wire on the Palais de la Bourse Such accidents, it is declared, might be easily prevented by the simple expedient of erecting lightning conductors at the point where the cable comes ashore, and at the terminus in

In the nineteenth annual report of the directors of the Zoological Society of Philadelphia, attention is called to the unprecedented destruction of many of the more valuable and important animals of the native American fauna, and to the need for the immediate adoption of every means which can be employed to save them from complete extinction The directors think that a good deal may be done in furtherance of this object, both in zoological gardens and private preserves. Of all the bisons now surviving outside the National Park, probably nine-tenths are comprised in a few herds owned by private individuals and zoological societies

A FINE tortoise, weighing 87 pounds, obtained by the U S Fish Commission steamer Albatron, during her recent visit to the Galapagos Islands, has recently been deposited in the Zoological Park at Washington, D.C The specimen was collected by Mr. C. H. Townsend on Duncan Island, and is of much interest, not only on account of the locality it represents, but as showing that Dr. Baur was a little hasty in deciding that Testudo ephisppium is only a synonym of T abingdoni Duncan Island tortoise agrees exactly with Dr Gunther's figure of T. ephippsum, and is entirely distinct from the Abingdon Island species, which is also well-figured in Dr. Gunther's paper. This foure shows a little emargination in the second marginal scute, which might seem accidental, but as it is exactly repeated in the specimen belonging to the U.S Natsor Museum, and as the emargination exists in the bony carapace, it is probably a constant specific character. Dr Gunther gives Indefatigable Island as the locality of T ephippeum, and if thes be correct the species occurs on at least two islands of the group. Besides the Duncan Island Tortouse, examples of T. victus and T. nierita are now living in the Zoological Park, while the U.S National Museum possesses skeletims of T abingdons (imperfect), 7 vicina, and T mgreta The locality of this last-named species is still uncertain, but there is som reason to suppose that it may be from Chatham Island. T migrata has the most arched carapace of any species, T. chistisum and T abingdons the longest and anteriorly most compressed and elevated carapaces. Between these lie in the order named T. manothyes and T vising. There is a direct correlation between the anterior height of the earnpace and the length of the neck, the rule being the higher the carapace the longer the neck. T' merita and T abinedoni having respectively the shortest and longest necks. Mr Townsend writes that tortoises are now extremely rare on Duncan Island.

This pine number of the Zologene contains an Interesting paper on the habits of the moves, by the J. G. Lockhatt. One of the points noted by the author is, that mose generally he with the tail to wardward, training to their senses of being and wriding, which are remarkably sents, to warn them of the word of the contraction of the contraction of the word in the contraction of the word in the contraction of the word in the contraction of the word them for midgate to least, where herming, and especially smelling, would be of little use. While they are sepling or chewigh to ed, their care as an paperpain linear, one landward, the other forward, alternately. They also have the remarkable in neight to make a short turn and sleep below the ward of their freel track, so that suppose failing thereon and following at pin sum to be heard or small before he can get deposing at pin sum to be heard or small before he can get

Ms L. Urcorr G11. has published as a pumphlet appared by the Rev II A Somet blooch the Bonnley Naturalian's Society on the scientific measurement of shildren Mr. Somes says he finds such measurements as he describes, taken every term, a good guide as to whether his pupils may be pressed until work or not. "If the increase is regular and the weight fair, escending to the height, I do not fair to press them, lust for most other hand, the weight so weight allow, or the height increases and the other hand, the weight is low, or if the height increase in the side with the side of the side of

THE first volume of Sir William Thomson's "Popular Lectures and Ashireuses" (Mommillan), has rasched a second collition. The third volume has also just been published, and the author hopes that the second volume may appear in the course of a year or two.

THE new number of the Journal of the Anthropological Institute (vol. xx, No. 4) peens with a paper in which Lady Welby calls attention to what she calls an apparent paradox in mental evolution. The number also includes a paper, by Mr. F. W. Rudfer, on the source of the just used for accept implements in Europe and America, and the Presidential address delivered by Dr. Beddoce.

THE B Manical Society of Edinburgh has issued the eighteenth volume of its Transactions and Proceedings. Dr. Antchson's "Notes on the Products of Western Afghanshan and of North-Eastern Persis," forming the first part of the volume, may be obblinded separatie."

Two new parts (62 and 63) of the elaborate dictionary of Chemistry included in the "Encyclopaedie des Wissenschaften" NO. 1127, VOL. 44] (Bresian: Eduard Trewendt) have appeared. The eighth part of the hand-book of Physics, in the same Encyclopedia, has also been published.

This midst edition of "Telegraphy," by W. H. Preces and is. Sleweight (Congman), has been published. The edition is described as "slmost a new book." No fewer than 24 figures have been altered and 44 excluded. On their are now affe as compared with 1941 in the last edition. The authors have aliand at "providing new a general introduction to the art and scarce of "providing new a general introduction to the art and scarce of the state of the st

Messas Longmans, Green, and Co are issuing the tenth edition of Quant's "Elements of Anstomy". It will appear in three volumes, and a being edited by Prof. E. A. Schafer and Prof G. D. Thane. The second part of the first volume—by Prof Schafer—has just been published. The subject is general anatomy or histology.

PART 32 of Cassell's "New Popular Educator" has been published. Besides illustrations in the text, it contains a coloured map of Switzerland

THE Geological Survey Department of Canada has assed the first of a series of descriptive and liturated quanto memorato not the Vertebrata of the Tentary and Certaceous rocks of the Canadan North West Territory, peapered for the Survey by Foof E. D. Cope, of Philadelphia The Report is devoted esclusively to a combieration of the species from the Industry Misconia deposits of the Cypress Hilly, in the district of Alverta, and consists of severy-seven pages of letterpress, tiliastrated of Alverta, and consists of severy-seven pages of letterpress, tiliastrated with control of the Vertebrate of the Vertebrate of the Laramse formation of the North-West Territory, by the same author, in now in cornes of preparation.

Mx Percy F Kendall has prepared a little volume ennitide "Hints for the Gudance of Observers of Useral Geology " it is intended to serve as an oniver to the request for gudance which have been made by members of the North-West of England Boulder Committer. The work is printed only on alternate pages, so that students using it will have space for occisional lived notes

"An approved Treatuse of Itawks and Ilawking by Edmind Ben," Info, has just been reprinted, with an introduction by Mr. J. E. Harting. It is the rarest of English books on falcony, and no copy has come into the market for early teenty years. The reprint is an early in facunitie as it is possible to make it without the and of photography, and a number of the market for the control of the property of the property

INDIGOCARMINE, the commercially important disulphonic acid of indigo, has been synthesized in an extremely simple manner by Dr Heymann in the laboratory of Messrs. Bayer and Co. of Elberfeld, and a description of the mode of operation is given in the new number of the Berichte The reaction merely consists in acting with excess of fuming sulphurle acid upon phenyl glycocoll, C₆H₃-NH-CII₃-COOII, the aniline derivative of glycolle acid. When a quantity of fuming sulphuric acid is poured upon a tenth of its weight of phenyl glycocoll in a test tube, the phenyl glycocoli rapidly dissolves, the acid becoming coloured vellow and slightly elevated in temperature. while sulphur droxide commences to be evolved. If the solution is then poured over ice the greenish blue colour of indigocarmine is at once obtained The best conditions for working the process on the large scale are as follows. One part of phenyl glycocoll is mixed with ten to twenty times its weight of fine sand so as to avoid local superheating during the process of addition to the fuming scid. The mixture is then introduced into about twenty times its weight of fuming sulphurie acid at a temperature of about 20°-25° The fuming acid should contain at least 80 per cent of sulphuric anhydride, and the temperature should be so controlled that it never exceeds 30° during the process of adding the mixture The yellow solution thus obtained vields instantly the blue coloration due to indigocarmine on removing the large excess of sulphuric anhydride by the addition of ordinary oil of vitrol, sulphur dioxide being evolved. Upon further diluting with ice and addition of common salt (indigo earmine being more difficultly soluble in salt solutions than in pure water) the colouring matter is precipitated, and may be readily isolated. The product thus obtained is found to consist of nure indigocarmine The tints obtained with this product are vastly superior in beauty and, clearness to those obtained with even the better kinds of commercial indigocarmine, on account of the higher degree of purity attained by this mode of preparation. The chemical changes occurring during the process appear to be as follow. The first product of the action of fuming sulphurte acid upon phenylglycocoll appears to be the

This substance, however, is unstable, and decomposes upon the removal of the excess of SO, into indigo disulphonic acid. sulphur dioxide, and water, probably according to the following equation-

$$2SO_{0}II - C_{0}II_{2} \\ SO_{0}II - C_{0}II_{2} \\ NII \\ SO_{0}II - C_{0}II_{2} \\ NII \\ C = C \\ NH \\ C_{0}II_{2} - SO_{0}II \\ SO_{0}II - C_{0}II_{2} \\ NII \\ C = C \\ NH \\ C_{0}II_{2} - SO_{0}II \\ SO_{0}II_{2} - SO_{0}II \\ NII \\ C = C \\ NH \\ C_{0}II_{2} - SO_{0}II \\ SO_{0}II_{2} - SO_{0}II_{2} \\ SO_{0}II_{2} - SO_{0}II_$$

Of course the most important point of commercial interest about a new reaction is the yield, and in this respect Dr. Heymann is very fortunate, for already 60 per cent of the theoretical has been attained The process has consequently been patented by Messrs Bayer and Co, and appears likely to become a very successful onn

THE additions to the Zoological Society's Gardens during the ast week include a Water Buck (Cobus ellipsipsymmus ?), a Leopard (Felis fardus), two Vulturine Guinea Powls (Numida vulturina), two Mitred Guinea Fowls (Nunnda mitrata) from East Africa, presented by Mr G. S. Mackenzie, F & S., a Peregune Falcon (Falso peregunus) from Scotland, presented by Mr Thomas C Smith , a Mountain Ka-Ka (Nester notabilis) from New Zealand, presented by Mr Herbert Furter, a Grey Squirrel (Sciurus griscus), a Squirrel (Sciurus sp. inc.) from North America, a Ducorp's Cockatoo (Catalua ducorper) from the Solomon Islands, pre-ented by Mr Nicholas O'Reilly , two Ravens (Corous cosas) from Ireland, presented by Captain Ogdby, a Cheetah (Cynclurus jubatus) from Persia, three Blandford's Rais (Mus blandfords), two --- Terrapins (Clemmys sp inc) from India, deposited , two Coypus (Myofotamus coypus) from South America, two Andaman Starlings (Sturma andamanensis) from the Andaman Islands, two Redbilled Hombills (Inccus crythrorhynchus), two African White Spoonbills (Platalea alba) from Africa, two Virginian Engle Owls (Bubo virginianus) from North America, purchased, a Red Deer (Cervus elaphus &), a Japanese Deer (Cervus sika Q), born in the Gardens

OUR ASTRONOMICAL COLUMN.

THE MERIDIAN PHOTOMETER.—In vol XXIII, of the Annals of the Harvard College Observatory, Frof. E. C. Pickering and C. Wendell give and discuss the observations made at Cambridge, U.S., with the meridian photometer during the years 1892-88. The observations relate principally to stars north of

NO. 1127, VOL. 44]

the declination - 40° Vol. xiv. of the Annals contained the the declination -40° vol. xiv. of the Annais contained the results of observations of the brightness of stars made with a small meridian photometer. The present volume deals with the photometric measurements of somewhat fainter stars, made by means of a similar but larger instrument

REPORT OF HARVARD COLLEGE OBSPRVATORY—Prof Pickering has just issued his Report for last year. He again urget the necessity of a fire-prof building for storing the 27,000 photographic plates of spectra, 9000 of which were taken in 1890. Legacies for the endowment of science in America are so common that it is not surprising to learn that the Observatory has received a gift of 25,000 dollars through the the Observatory has received a gift of \$5,000 dollars through the take Mr J I Bowditch During the past year; 1500 photolate Mr J I Bowditch During the past year; 1500 photonoise at the station near (I osses, in Peru. Nertly all of them
relate to the region ostul of -20 Mr. Draper has added
another instrument of the same kind to the Henry Draper
Minorial. This is mounted in the Observatory grounds at
Cambridge, and since September 1850, 2137 photograph
have been taken with a, covering the sky north of -20 Mr.

By the state of the same the state of -20 Mr.

T placing a prism of small angle over the objective, the spectra of stars as faint as the tenth magnitude have been obtained. Ser stars as fant as the tenth magnitude have been obligated. See such Type IV, spetch shaw been discovered: Spectra stars, with Type IV, spetch shaw been discovered: Spectra the phylogen time F isas been abown to be bright in eight intercept, there having been added to the list during the perty caph, three having been added to the list during the perty which the hydrogen hies are bright at maximum. This peculantly has furnished a means of discovering seven new variable stars. The 11-and, beleacep has here not for a default which yet a star of the star of of the spectra of the brightest stars, with the result that B Aurige and CUrse Majoris have been discovered to be close binaries One photograph of or Herculis seems to show that this star also is double, but this has not been confirmed. With the 12-inch telescope a number of "canals" on Mars have been recognized, but only one of them was distinctly seen to be double. An important accession to the white spot surrounding the southern pole was found by photographs to have occurred between the nights of April 9 and 10. The Report concludes with a list of the numerous publications issued by the Observatory during the vear

THE SOLAR PARALLAX AND IIS RELATED CONSTANTS.

I would be difficult to conceive a more masterly and comprehensive exposition of astronomical and physical constants than one just issued by Prof W. Harkness, of the United States Naval Observatory As is rightly pointed out, "The solar Naval Observatory As is rightly pointed out, "The solar parallax is not an independent constant. On the contrary, it is entangled with the lunar parallax, the constants of procession and nutation, the parallactic inequality of the moon, the lunar inequality of the earth, the masses of the earth and moon, the ratio of the solar and lunar tides, the constant of aberration, the velocity of light, and the light equation." It should therefore be determined simultaneously with all these quantities by means of a least square adjustment, and Prof Harkness develops such The equations connecting the constants are given, whilst the numerical values which are discussed are based upon n enormous mass of astronomical, geodetic, gravitational, and tidal observations which have required more than two hundred years for their accumulation. The sources of prohable error are also examined, and it is suggested how some of the constants may be improved in the future. The completeness of the lists of constants, and the careful manner in which they are discussed and corrected by the comprehensive least-square adjustment which is developed, justifies our giving serialist the results obtained — Equatorial semi diameter of the earth-

396 ; 124 ± 0 078 miles. Polar semi-diameter of the earth-3949 922 ± 0 062 miles. One earth quadrant 10001816 ± 125 1 metres. Oblateness or flattening of the cartl --1/300 205 ± 2 964.

Eccentricity of the eartha-u06651018.

```
Mean density of the earth-
                       5.576 ± 0016.
Surface density of the earth-
                        2'56 ± 0'16.
Length of the seconds pendulum ( = latitude)-
             30 012540 + 0'208268 sin's inches.
Acceleration due to gravity-
              32 086528 + 0'171293 sin2p feet.
Length of the sidereal year-
                    365d 6h. om. 0 3148.
Length of the tropical year at time /--
       365d, 5h 48m 46 069s. - 0.53675s. (* - 1850
Length of the sidereal month-
      27d. 7h 43m. 11 524s. - 0 022671s
Length of the synodical month-
      29d. 12h. 44m. 2 8418 - 0 026522s. (1 - 1800
Length of the sidereal day-
              86164 09965 mean solar seconds.
Ratio of the mean motions of the sun and moon-
                      0.074801320112
Mass of Mercury (Sun = 1), 8374672 ± 1765762
        Venus
                            408068 ± 1874
        Forth
                            127214 ± 624
        More
                            3093500 ± 3295
        Jupiter
                            1047 55 ± 0 20
        Seturn
                            3501 6 ± 0 78
        Hranus
                              22600 ± 36
        Neptune
                             18780 ± 300
        Moon (Earth = 1) 81 068 ± 0 238
Constant of solar parallax-
                    5" 80905 ± 0" 00567
Mean distance of earth from sun-
                  92796950 ± 59715 miles
Eccentricity of the earth's orbit-
                        0 016771049
Lunar inequality of the earth-
                    6" 52294 ± 0" 01854
Lunar parallax-
                  3422" 54216 ± 0" 12533.
Mean distance from earth to moon-
                  238854 75 ± 9 916 miles.
Eccentricity of moon's orbit-
                        0 054899720
Inclination of moon's orbit-
                       5° 8′ 43″ 3546.
Mean motion of the moon's node in 3651 days-
         - 19° 21' 19" 6191 + 0" 14136 (t - 1800
Parallactic inequality of the moon-
                    .
124" 05126 ± 0" 08107.
Constant of luni solar precession-
50" 357 10 ± 0" 00340.
                    9" 22054 ± 0" 00859.
```

Constant of aberration-

20" 45451 ± 0" 1258. NO. 1127, VOL. 44] The time taken by light to traverse the mean radius of the earth's orbit (the light equation)—

498'00595s. ± 0'30834s.

The velocity of light in vacuo per second of mean solar time— 186337.00 ± 49.722 miles

In order to imbrove the system of contains sile-raned, Prof. Hardness thinks have the system of contain should be destrained by the disural method at one or more stations as near as possible to the equator, and that the Observationes in the northern and southern hemspheres should so-operate with each other for not some stations and the state of the state

The laborous character of an investigation which leads to the results here given is patent to all. To say, therefore, that all the computations involved were made and checked by Prof. Harkness himself is to testify to industry very rarely excelled.

TECHNICAL EDUCATION IN RUSSIA.

An interesting report on technical education in Russia has been laid before Parlament by the Foreign Office. It is a digest by Mr. Hafford of a very olumnous Report, compiled by Mr. Anopost, Director of the Nicholas Industrial School at S Feterbarg, on technical education in Russia, and is described by Sir K. Monter agiring an extensive review of all the properties branch of the state of the

schools about to be founded.

M. Anopoff contineth himself to giving full testals of intermonatorism, without attempting a description of the higher
institutions, without attempting a description of the higher
schools. The cubhishment of these former classes of schools
dates, he says, from only young 25 years hack, but in that short
dates, he says, from only young 25 years hack, but in that short
leads to be a second of the second of the second classes of schools
dates, he says, from only young 25 years hack, but in that short
to be a second of the secon

sects exclusively connected with railways, no account of them is given. (3) Industrial schools with a course of general education not exceeding the scope of the course of primary schools, or sometimes reaching the standard of the second class in village sometimes reacting the standard of the second class in village schools with two classes. In most of them pupils are received who have completed the course in the public school, and who repeat what they have gone through in it. These schools are founded with the object of preparing skilled artisans for village tounces with the object of preparing skilled artisans for village and domestic industries, and also factory hands. They contain workshops for joiners, blacksmiths, carpenters, fitters, tailors, shoemakers, saddlers, bookbinders, &c, but few of these institutions can boast of a systematic course of instruction in trades (4) To this group belong various special and general educational schools for adults, as the school for foremen builders, the school sidoots for adults, as the school for foremen builders, the school for printers, the evening and Student special classes of the Imperial Technical Society at St. Petersburg, the Rigg. Industrial School, &c. The teaching in these institutions takes place in the evenings of week days, and on Studeys, s. s when the adult workmen for whom they are intended are free from their work. (5) This group consists of elementary schools of general education, s. s. printers, datrick, or municipal whools with supplementary industrial section I. 18 wordly for date that person of the students of the schools of these schools of the schools of t certain standard, at any of the schools of these five groups, enjoy certain privileges with regard to exemption from military service The report then goes on to describe in detail the courses of some of the leading industrial schools as types of the different groups, as well as of the industrial classes attached to the elementary schools In conclusion, the report summarizes the more important provisions of the ukase of March 7/19, 1888. reschools may be opened in Russia, either wholly or in part, as the expense of the State (given in Appendices I, II, III) The cost of maintenance of these schools is respectively estimated in cost of maintenance of three schools at respectively estimated in the usase in follow the intermediate incchanneal technical schools at 27,311 (2735) per annum, the elementary mechanical technical schools at 19,450 (2756) per annum, and the trade schools at 11,950 (2750) per annum. The Ministry of Folusion has assigned for this year the sum of £50,000 for the creation of these technical schools, and it is reported that the Ministry has been urged to devote a consider reported that the atinistry has been urged to devote a consider able portion of this sum to founding schools in the districts where village industices prevail, the richer manufacturing districts being better able to dispense with State aid. The provisions of the ukase are —(1) The industrial schools for the male inhabitants of the Empire exist for the purpose of diffusing among the population technical education of the intermediate and elementary standards, as well as instruction in handreafts. ementary standards, as well as instruction in handicrafts and elementary standards, as well as instruction in handicratis (2). The intermediate technical schools impart the instruction and skill indispensable to artificers who are destined in time to act as the trusted assistants of sequencers and of other managers of industrial enterpraces (3). The elementary technical schools, besides intermediate on the time of the control of the co definite handicraft, likewise impart the knowledge and skill indispensable to men whose duty it will in time become to act as indispensable to men whose duty it will in time become to act as master-workers and immediate overseers of the operations of artisans in individual consistence of the operation of artisans in individual consistence intrins in the methods of any one trade, and at the gracuate intrins in the methods of any one trade, and at the gracuate intrins in the methods of any one trade, and at the gracuate intrinsical consistence of any one trade, and at the gracuate interest in the interest in the consistence of any one trade work of such trade. (5) Industrial schools of each of the above-mentioned categories and east either apart or conjunction with other similar schools of various degrees and (7) The industrial schools are supported at the expense of the Crown, or of the sensitives, societies, guilds, or private individuals, or by funds contributed simultaneously from all these sources (8) The course in the intermediate technical schools is not to exceed four years; that of the elementary and trade schools three years (9) Those who enter trade schools are required to produce a certificate of their having gone through the course of an elementary school, those who enter the elementary technical schools, a certificate of having gone through the course in a municipal school, or village school, with two classes, while in a ministryal school, or village school, with two classes, while those who enter intermediate technical schools must have gone shrough five classes of a Kraitziuli. (10) Those who are unable to satisfy the conditions mentioned in the preceding paragraph, but who have worked not less than two years in industrial institutions, and have proved that they can successfully follow the course at the school they wish to enter, may be also admitted. (11) Industrial schools must have (2a is library, 0b) a room with

appliances for geometrical and freehand drawing, (c) where possible a room with appliances for modelling, (d) the necessary methods and appliances for modelling, (d) the necessary methods, and in addition the requisite appliances for the practical work of the apprentices (14) Fupils who have exceedibly empleted their effection in an intermediate techniques of the second of the after three or two years respectively, spent uninterruptedly in industrial work. Those who are so styled obtain certain privileges as regards their civil status and in respect to military service, and they emoy in addition the right of entering the higher technical schools Those who have completed the course at the other two categories of schools enjoy the privileges as regards civil status and military service which correspond to the general education they have received

FOSSIL FISH OF THE SCANDINAVIAN

MR DAVIS his availed himself of the opportunities pre-sented to him by the chief officers of the Museums of Lund, Stockholm, and Copenhagen, and has published a mono-graphic account of the fish remains from the Cretaceous formations of Scandinava

Over seventy years ago Sven Nillson first discovered fish re mains in the Swedish chalk S.nce then numerous large collec tions have been made by the officers of the Geological Survey of Sweden and others, and the greater number of these specimens Sweden and others, and the greater number of these specimens were unreservedly placed at the disposal of Mr Davis for description in his memoir, he has also had the opportunity of consulting some smaller collections in Sweden, and most of the forms have been figured from the original specimens by Mr Crowther These fish remains show a closer relationship to the Cretaceous

"These fish remases show a closer relationship to the Createcous fish remains of the north of Europe, as represented by the English and French chalk fish, than to the more highly specialized chalk fish under James Marion, but they do not afford the control of c and of that of Central Europe generally, whilst it affords com-paratively few data for comparison with that of Lebanon The paratively few data for comparison with that of Leonanon 1 ne occurrence of numerous tech of several species of Scapano-rhynchus in the Swedsh area is worthy of note, but the fish are not found preserved bothly as they are in the clusk of Lebanon This memor is published as Part vi. of vol 1 v. of the Transactions of the Royal Dublin Society, and is illustrated

with an atlas of nine plates.

SOCIETIES AND ACADEMIES. LONDON.

Royal Society, May 28.—"On the Bases (Organic) in the Juice of Flesh Part I" By George Stillingfieet Johnson, M R.C.S., F.C.S., F.I.C. Communicated by Prof. G. Johnson,

The author has endeavoured to ascertain by careful experi-The author has endeavoured to ascertian by careful experi-ments how fast he substances thirteen prepared from field have re-ment how fast he substances thirteen prepared from the ducts, due to (1) the science of absumed or physical agencies, applied in the course of extraction, or (2) to bacterial scition modifying the composition of the flesh before it comes into the The final conclusion drawn is but ascroak tractice is not present in fresh muscle, but results from bacterial action whereas ascroak extraints is probably a true "deuch action"

Chemical Society, May 7,—10; J. H. Gitchtone, F.R.G., Vice-President, in the chair,—The following papers were read,—The action of alkalis on the nitro compounds of the paraffia series, by W. R. Danstan and T. S. Dymond. The paper contains the results of further investigation of the inter-action of alkalis and nitroreshine, of which a perfumery account acieno o alkalis and nitrochane, of which a prelimancy acousts have already been given (Chem. Soc. Proc. 1835, p. 12).

Late already been given (Chem. Soc. Proc. 1835, p. 12).

Carbon dioxide, and the alkali derivative of nitrochane, which is obtained when alkali hydrocide is employed. Amounts compound, to be the with nitrochanes in the cold to form a crystaline compound, of alkali proceeds further on warming, and there are formed alkali intritic, accommending the compound, boiling at 171, and solidlying to a crystaline mass when cold to 3'5. The authors fin I that this compound is trimethylisoxazole

It is very stable, and is almost unaffected by heating in closed It is very stable, and it almost unaffected by heating in closed tubes with strong acids and aliasis. Permanganae conducts it to accuse and oralic archia. By credening agents it is abovely decomposed with formation of annotations of an experimental accuse and accuse and oralic archia. By credening agents in 100 pt of 100 pt acted on by alkalis, yields triethylia xxaole, propionitrile, and alkali nitrile, but the reaction occurs with greater difficulty than in the case of nitroelihane. Nitromethane is readily acted on by alkalis, and hydrogen cyanide, alkali intrite, and much resun are formed. The parent noxable could not be isolated. Secondary, and the statement of the parent noxable could not be isolated. are formed. The parent hoxazone could not be assisted occupa-ary nurropropane is attacked with difficulty by alkalis, and no isoxazole is formed .—Some new a idition compounts of this carbande which afford evidence of its constitution, by J E keynolds, F.R.S. Thiocarbands combined with the constitution of the carbands combined the combined combined combined the combined combined the combined combined combined the combined combined the combined Thlocarhamide combines with ammonium bromide, todide, and chloride at the temperature of boiling alcohol, and forms compounds of the type (H4N,C5),H4NR. Under the conditions specified no compounds were obtained Onder the conditions appearance in compounds were containing less than four molecular proportions of the amide to one of the ammonium haloid salt. M-thyl, ethyl-, allyl-, phenyl-, diphenyl , and acetylphenyl-thiocarbamides do noi phenyl; appenyl, and acetylphenyl-thiocarbanides do not yueld compounds with amm nium bromide at the temperature of boiling alcohol Thiocarb mide and tetrethylammonium bromide and todde yield compounds of the type (H,N,C),Ft,NR Under the experimental conditions, no well defined substance and solded yield compounds of the type (II,N,C.),P(,N,N). Under the expressional conditions, no well desided substance was obtained containing more that two molecular proportions was obtained containing more that two molecular proportions of the containing more than two molecular proportions of the containing and the compound (II,N,C.),NeII,NII: Thocarbamide, when treated with relevant more than the compound (II,N,C.),NeII,NII: Thocarbamide, when treated with relevant more than the compound (II,N,C.),NeII,NII: I does not, however, combine with chylamonium brounds; and when heated with the sait in the compound (II,N,C.),NeII,NII: I does not, however, combine with chylamonium brounds; and when heated with the sait in the chylamonium brounds; and when heated with the sait in the chylamonium brounds; and when heated with the sait in the chylamonium brounds; and when heated with the sait in the chylamonium brounds; and when heated with the sait in the chylamonium brounds; and when heated with the sait in the chylamonium brounds; and when heated with the sait with alcohol, it yielded elip) coules and either than the chylamonium brounds; and when heated with the sait in the chylamonium brounds; and with alcohol, it yielded elip) coules and either than the chylamonium brounds; and with alcohol, it yielded elip coules and tentum of the chylamonium brounds; and with a chylamonium brounds; and with the chylamonium brounds obtained. Prolonged heating produces a secondary re-

NO. 1127, VOL. 447

action expressed by the equation R.NCS + CH₂COOH = CH₂CONHR + COS. In the case of fatty thiocarb-amides a well-defined acctylated thiocarbamide is first produced, amilies a weit-tennice accipiance information of missard oil, and prolonged heating gives rist information of missard oil, but the yield of the latter is never high, and as final product a substituted amide is produced—The decomposition of silver chloride by light, by A. Richardson. When pure silver chloride is exposed to light under water oxygen is evolved, part of which is present as ozone, when small quantities of water are present, chloring and hydrogen chloride are found in solution, with large chlonne and hydrogen chlorule are found in solution, with large quantities of water, hydrogen chloride, but no chlorine, is found. The influence of hydrogen chloride in restanting the decomposition of silven chloride is considered, and is explained from extended to the control of hydrogen chloride exercise a marked influence on the stability of chlorine water when exposed to thigh, the rate of decomposition of the silver chloride being dependent on the readiness with which the chloride being dependent on the readiness with which the chloride is notion to always and water interact to form hydrogen chloride. The author describes exprenents which should be controlled to the chloride controlled to the c to light contains no oxygen, and he concludes that it is of the nature of a sub chloride rather than an oxychloride.—The addi tion of the elements of alcohol to the ethereal salts of unsaturated tion of the elements of alcohol to the elements again of unsaturated acids, by T. Purdte and W. Marshall The authors record the results of experiments on the addition of the elements of alcohol to ethereal salts of fumaric and maleic acids by the agency of small quantities of sodium nikylate, they also describe a scries of experiments with other ethereal saits, the object of which was to ascertain if the ethereal saits of unsaturated acids in general are capable of undergoing the same additive change general are capable of undergouag the same additive change by the action of a small quantity of ordium methylate in the cold and the same of the attaches itself to the β -carbon atom. Ethylic methacrylate also formed additive compound, but pure products were not obtained formed additive compound, but the products were not obtained methylic and ethylic cimanast ϵ and ethylic ϵ (β) ethyleumants do not undergo additive change.—Noise on the axo-derivatives of β naphthylamine, by R. Meldola, F R S, and F Highes The authors have completed the series of an oderwatives obtained to the series of an oderwatives of the series of the series of the subcess that the series of an oderwatives of the series of the subcess that the series of an oderwatives of the series of the series of an oderwatives of the series In author's have completed the series of all overvaires outlinable from the intrainines and β naphthylamine by preparing orthonitrobenzene alo β naphthylamine. The latter by the action of nitrite in a warm actic acid solution gives orthonitrobenzenesco β-naphthol. In cold alette acid solution the naphthyl acctate is formed. Actyl derivatives of the the naphthyl acetate is tormed. Accept derivatives on me orthor, meta, and para-infrozac-derivatives of \$\textit{\textit{m}}\$-apphthylamine have also been prepared. The pseudazimides from the para and metanitro compounds have been prepared. These

compounds have the formula $C_{10}H_{\bullet} \stackrel{"}{\underset{N}{\bigcirc}} N \cdot C_{\bullet}H_{4} \cdot NO_{\bullet}$ (p or m). The action of aldehydes on these B naphthylamiae azo-derivatives gives rise to the formation of triazines, which aco-derivatives gives rue to the formation of trainies, which are being investigated —A method for the eximation of intrains, are being investigated in the control of the

Enlarges and except, May 34.—Ansacreasy Mentage—Prof.
Linnean Step in the chair—The Tensurer presented his
Annual Report duly sudied, and the Secretary having associated
the elections and death during the part twelve month, the susal
ballot took place for new members of Council, when the followLister, St. G. Mayrat, and F. W. Oliver. The Fresident and
officers were re-elected. The usual formal business having been
canasacted, the Freedent proceeded to deliver his annual address,

taking for his subject "The Secondary Sexual Characters of Admands and Plants," of which he gave several interesting examples, illustrating his remarks with graphes sketches in coloured chafts. On the motion of Mr. H. Druce, seconded by Mr. C. Tyler, a vote of thanks was accorded to the President for his able address, with a rangest this has more?" Typer, a vote of thanks was accorded to the President for his able saddees, with a request that he would allow it to be printed.— The Lannean Society's Gold Medal for the year 1891 was then formally awarded to Dr. Edouard Bornat, of Paris, for his researches in botany, and on his behalf was presented to M Raymond Lecomte, Secretary to the French Embassy The proceedings then terminated.

Institution of Civil Engineers, May 26.—Annual General Meeting.—Sir John Coode, K.C.M.G., President, in the chair—In the Report of the Council for the session 1890 91, it was —In the Report of the Council for the session 1890-91, it was remarked that the salient feature of the session, now term-nated, had been the realization of a proposal made more than forty years ago—namely, the formal reception by the President and Council on stated evenings after the ordinary meetings of the members and visators then present. A sense of recognition was hald after the ordinary meetings in the months of January, when the ordinary meetings in the months of January, and the ordinary meetings of the present and the present and the present and the present and to the models and other objects of motted to be present and to the models and other objects of motted to be present and to the models and other objects of motted to be present and to the models and other objects of the motted to be present and to the models and other objects of the motted to be present and the present of the motted to be present and the present of the present o the members and visitors then present. A series of receptions the roll of the Institution during the past year was 247 The number of members of all classes, students excepted, on March number of members of an classes, students excepted, on march 33 last, was 5150, as against 4903 on the same day last year, representing an increase at the rate of 5 per cent.—The adoption of the Report was moved, seconded, and carried, and it was ordered to be printed in the Minutes of Proceedings Cortial votes of thanks were then passed to the Prescuellent, to the Vice-Presidents and other Members of the Council, to the Auditors, to the Secretaries and Staff, and to the Scrutineers -Addition, to the Seatisties and Staff, and to the Seatisties. The ballot for Council resulted in the election of Mr, Leorge Berkleya Prendent, of Mr. H. Hayter, Mr. A. Gales, M. P. Sitt. Programs Back, C. M. G. J. Wolfe Barry, Mr. E. A. Cowper, Sir Jan N. Douglass, F. R. S. Yose-Pre-duction, and of M. W. Househaw, Mr. A. M. Charles Seating of the Council Results of bers of the Coulect — a necession was adjourned until the second Tuesday in November, at 8 p m [At the first meeting of the newly elected Council, the following officers were re appointed Mr H L Antrobus, as Treasurer, Dr Wm Pole, FRS, Honorary Secretary, and Mr. James Forrest, the Secretary]

EDINBURGH. Royal Society, May 4—Sir Dougles Machagan, Presilent, to the chair—A preliminary note by Mr. John Aitken, on a method of observing and conting the number of water particles in a fog, was communicated. The phenomena which are denoted by the names fog, mat, and ran, differ merely in cleaning the name for the control of the phenomena which are in the name for the present the present in the art to a greater of as seen. The haze turns into a fog degree, and not in sino.

In a naze dry dust particles are present in the air to a greater or less extent. The haze turns mino a fog when water vapour is condensed upon the particles, and the fog will develop into mist upon the condensation of a sufficient amount of moisture. So that we may regard an ordinary fog and a mist as a dry fog and a wel fog respectively. The water drops in a fog will gradually settle upon the exposed surfaces of bodies. Hence it might seem that, in order to determine the soules. Hence it mignt seem tank, in order to determine the extent to what mossture is present in a fog, it would be sufficient to allow the drops to fall upon a piece of mirror, which they would soon wet. Met M. Aitken has found that when exposed surfaces are quite dry, a great quantity of water drops are often present in the air. The drops are exceedingly small fault evaporate with great rapidity from the surfaces (heated by the company of the present that the present the surfaces these of the present that the present the present the present the present the present that the present the by radiation) upon which they fall. The instrument which Mr. Attien has adopted for the purpose of determining whether or not water drops are present is essentially identical with his pocked-usic counter. It consists of a glass micrometer divided into equates of a known axes, a spoj mirror for illuminating the expense of the control o

working with a magnifying lene. In one fog which was ob-served, objects at a greater distance than 100 yards were quite invisible, and the surfaces of exposed objects were quite dry. The number of drops which fell jer minute varied greatly, sometimes reaching 3000 per square centimetre, sometimes only
300 per square centimetre
Two days later the same apparent 300 per square continuere Two days later the same apparent external conditions regarding fog again obtained, and the number was found to be 1300 per square centimetre per minute number was found to be 1300 per square centimetre per munute—which remained fairly constant until the fog began to clear off when it slowly diminished. In both cases the observation was made at to a m. If the stage be slightly heated, the drops never teach the surface but evaporate in the layer of bested at over it. Mr. Aitlen has slow modified this apparatus in order over it. Mr. Aitlen has slow modified this apparatus in order to admit of the counting of the number of drops which fall from to admit of the counting of the number of drops which fall from a column of air of known height. A low power microscope is used, and so a column of air 3 centimetres long can be obtained over the stage.

Underneath, and concentric with the nucloseepe, a tube 5 centimetres long and 4 centimetres in diameter is mounted. The top and bottom of this tube can be simulaneously closed by covers which turn on an axis parallel to the necessary closed of covers when turn on an axis parallel to the axis of the tube. A micrometer, illuminated by a spot mirror, is fixed in the centre of the bottom, and, in the centre of the upper cover, a small opening which corresponds to the lens of the microscope is made. The former instrument may be seed to observe the larger particles or disas in the stimospher.—1):

[1] M. Macfarlaine read is paper, illustrated by lantern demonstrations, or a comparison of the minuted structure of plant. hybrids with that of their parents. He finds that the minute structure of the hybrid, like the larger features, is always intermediate in character between the corresponding structures. of the parents

Academy of Sciences, May 25 -M Duchartre in the chair — Researches on the camphene series, by MM Berthelot and Matiguon — Researches on the vapour tension of siturated and Maligaon — researches on the vapour tension of structure where vapour at the entirely point, and on the determination of this critical point, by MM Cailletet and Colasdeau In a recent most (Compts; rendits, so Cut p 561, 1891) the authors communicated to the Academy a new method for determining critical tensions. obtained in the case of 'water'. Six series of experiments with different weights of water indicate that the critical temperature is 36% C, the critical pressure whith corresponds to this being no 5 atmospheres—On the analysis of the waitight diffused by the sky, by M A. Crown. If B be the intensity of the being that diffused by the sky, and S be metering of medient sum-light, it may be shown that $\frac{1}{n} = 100 \binom{56}{3}$ %, where 56% reports each temperature of the three control of the spectrum, and m is an empirical coefficient. M. Crown calculates values with m + q and $m + q \leq 3$, and finds that, although Lord Rayleigh's ubservations (Phil. Mag., 1871, 1971) are set in Section 16 and 1 obtained in the case of water Six series of experiments with peel in accord in the former case, his own observations at Monj-pellier give results which are better represented when the latter value of m is used,—On the relative age of the Quaternary stratum of Mont Dol (Ille et Vilaine), by M. Sirodot. The author's observations lead him to believe that the dibris on Mont Dol belongs to an epoch anterior to the movement which in Quaternary times elevated the coasts of certain regions of the in () maternary times elevated the coasts of crimin regions of the Blaite Sea — On the exact determinant in of the glycoline power of the Blaite, Sea — On the exact determinant in of the glycoline power with the Please and the properties of the Blaite of the Sea o as the "black urop was not observed — Inc amougners conditions of Greenwich with regard to the universal bon question, by M. Tondini. The cloudy state of the Carenwich sky, and the many ramy days recorded at the Observatory addition of Greenwich as the prime mendan. The merchan of Jerusalicia. Nyana is said to possess numerous atmospheric and other advantages —On the algebraic integration of differential equations of the first order, agetriac integration of differential equations of the integrals of by M. Painted—On the determination of the integrals of the integrals of the integrals of the integral of the interno electricity, by M.M. Chasagon and Abrian of the real of the interno electricity, by M.M. Chasagon and Abrian Determination of the solar constant, by M. R. Savélief. From an antanomeric curve obtained on December 26, 1890, the author

obtains for the solar constant, reduced to the mean distance of the sun from the earth, the values [3/4] calories. Langley's value, from his Monnt Witney observations, was 30 calbrids.— On the fluctuations in the heights of lake water, by M. P. du Boys. In lakes, and particularly in the Lake of Geores, the surface of water regularly its set not pert and lowers in agother, surface of water regularly in the superior of the surface of water surface of water regularly in the surface of the surface of the level is practically constant is called the node, and the nove-ments referred to go by the name of stracks. The subtreviews-tigates this wave motion mathematically.—On a new portable counding-apparatus of steel wire, by M. Emile Bellios—Study of the bacometric gradient, by M. G. Guilbert. Some remark-ration are over—Relation between atomic worth and the obtains for the solar constant, reduced to the mean distance of gradient are given.—Relation between atomic weight and the density of liquids, by M. Al. Moulin —On the sub-chloride of silver, by M. Gintz. Under the action of heat, the subsilver, by M. Gantz. Under the action of near, the sun-chloride decomposes into silver and silver chloride. This decomposition is easily seen by the change of colours of the sub-chloride. Dilute nume and has absolutely no action upon the compound. With his concentrated nume and, chloride of silver mixed with the sub-chloride is obtained. Potassium cyanide rapidly dissolves the compound, and decomposes it.
Utilizing this reaction, the author has found that a given weight Unliving this reaction, the author has found that a given weight or choined sineages practically the same amount of heat with Ag.—Action of potatsuum alits upon the subhibity of potatsuum choine, by M. Ch. Binter.—Electropius of the lased salts of boron and witcon, by M. Adolphe Minet. Some and the subhibity of which the subhibity of the subhibity of when the subhibity of when the subhibity of when the subhibity of when bodies in methyle, subhy, and proof) alcoholy, of the subhibity of when bodies in methyle, subhy, and proof) alcoholy, of the subhibity of when bodies in methyle, subhy, and proof) alcoholy, of the subhibity of when bodies in methyle, subhy, and proof) alcoholy, of the subhibity of when bodies in methyle, subhy, and proof) alcoholy, of the subhibity of when bodies in methyle, subhy, and proof) alcoholy, of the subhibity of when the subhibity of the of chlorine disengages practically the same amount of heat

120

MELBOURNE

Royal Society of Victoria, March 12 -The following Royal Society of Victoria, March 12—The following officers were cleed for the year 1891:—Freedom: 170 Kernot. Treasurer C R Blackett Secretaries H K kuden and Frod W Baldwin Spencies.—The following papers were read:—A new species of Dictyonema, by T S Hall—A preliminary account of Vinutie publishing. A Arthur Dendy This is a new genus and species of calcarous spongs, which is allied to Ute, but in which the individuals are lived together into

allied to Ute, but in which the individuals are fused fogether into a common maw—The geology of the southern portion of the Moorabool valley, by T S Islal and G. B Pretfeatd.
April 9 — On the occurrence of the genus Belonostomus in the April of the Common of the genus Belonostomus in the Moorabool of the British (Common of the Common of the Grand of the British Western Tass as described as a nave peeus, under the name of Belonostomus recent —Note on a new genus of Chetopod worm parasite on a sponge of the genus Maphadophius from Port Philip, by Trof W Baldwin Spencer The worm is remarkable in having the domain strikes overed with a series of fores of setze, each row enclosed in a membranous web, the bunches of sette on the feet are also enclosed in webs

GOTTINGEN.

Royal Academy of Science—In the Journal of the Scientific Academy of Scientific—In the Journal of the Scientific Academy of Gottingen, the following papers of scientific universal appear (July 10 December, 1890)—
July—Fr Pockels On the Interference phenomena of convergent homogeneous polarized light through twin-plate smaxal crystals—Voigt: Determination of the elastic constants of Brazilian tourmaline.

Bratilan tourmaine.
August — Julius Weingarien On particular integrals of
Laplace's equation, and a class of fluid motions connected with
the theory of munimum surfaces — Venales: A modification of
Hermite's first proof that s is transcendental — Riecke: Special
cases of equilibrium of a system having several phases.— Meyer
Discriminants and resultants of angularity equations (second

notice).-Burkhardt: An equation in the theory of the theta-functions.-Klein: On the zero-points of the hypergeometric

October. -Nernst : On the distribution of a substance between

two olorents.

December.—Riccke. The thermal potential of weak solutions.
On electronication by friction.—Meyer: On discriminant and
resultants of alapharity quantions (third notice).—Volgt: On
and electrolytic conduction.—Hurwits: On the zero points of
the hypergonentne senses—Volgt Determination of the constants of elasticity of several non crystalline minerals.—
Autrobach On hardness and its absolute measurements.

Royal Academy of Bennece, May 13—The elements of the hydrography of the Kuttegati and Skagerack, by Prot O. Petterson—Skuder on the Solenozatre, it monograph of Chataleman mitalinium, by Dr. A Wirkn—Researches on the Lovin gave a report on the work executed during the last summer at the reological station of Kristineberg in Bohaslan, Sweden, and renewed a paper by Dr. C. Aurullius on the symbools between Pagurus and Hydractina as well as another by Dr. Wirkn on Chesistic man studies. servations on the method of Koch in treating tubercular diseases servations on the method of Koch in treating tubercular diseases by Prof Bruzelins — A copper-plate engraving of a map of the world made in the beginning of the filteenth century, formerly belonging to the museum of Cardinal Borgia in Velletri, described by Baron A E Nordenskuld — Studies on the brain of telearteous fishes, by Herr G Andersson Maime -A final contribution to the flora of the Chlorophyllophysæ of Siberia, by Herr O. to the flora of the Chlosophyllophysis of Viberia, by Herr O.

F Borge —On phene-thi-)-propil and phenyliso-propyi-trasol
combinations by Irr A Bladin.—On the specific heat of
water between of and 4-60, by Herr A M Johansson.—A few
formulae to calculate the mortality among annuitants of public
offices and private societies by Dr. G. Eastrom —A comparison offices and private societies by Dr. O. Fination — A. Comparison between the methods of Ang-trom and Neuman for determining the conductibility of lient in bodies, it experimental researches, Dr. Hagatrom —Hydrographical researches in the Guillman ford during the summer of 1890, by Miss A. Palmayist.

CONTENTS.	PAGE
The British Institute of Preventive Medicine	97
The Geology and Physical Geography of North	. 9/
Syrla By Prof Edward Hull, F R.8	
European Botany By J G. Baker, F R.S	. 100
Our Book Shelf:-	, 100
"The Missouri Botanical Garden"-J G B	101
Hermite . "Geologie Principes-Explication de	
l'Époque Quaternaire sans Hypothèses "-C R,	102
"Webster's International Dictionary of the English	ı
Language"	102
Harrison: "Elementary Chemistry for Beginners". Leffmann and Beam. "Examination of Water for	. 102
Leffmann and Beam. "Examination of Water for	r
Sanitary and Technical Purposes"	. 102
Letters to the Editor:	
The University of London - Prof. Karl Pearson	:
Dr A Irving; Thomas Tyler; R D. Roberts	
G H Bailey	102
Quaternions and the Ausdehnungslehre -Prof. P.	
G Talt	. 105
The Spinning Ring -Right Rev Blahop Reginald	
Courtenay; Prof Oliver J Lodge, F R.S.	. 106
The Use of Startling Colours and Noises —Alfred O.	. 100
Walker	
	. 106
The Formation of Language -W. J Stillman .	106
Cordylophora lacustris - John Bldgood	. t o 6
On some Points in the Early History of Astronomy	
IV. By J Norman Lockyer, F R.S	. 107
Botanical Enterprise in the West Indies .	110
Notes	
Our Astronomical Column:-	
The Mendian Photometer	. 115
Report of Harvard College Observatory	. 115
The Solar Parallax and its Related Constants	. 115
Technical Education in Russia	116
Fossil Fish of the Scandinavian Chalk	117
Societies and Academies	117
	/

THURSDAY, JUNE 11, 1891

MAMMALS LIVING AND EXTINCT

An Introduction to the Study of Mammals Living and Extinct By W H Flower and Richard Lydekker (London Adam and Charles Black, 1891.)

THIS work is, as the authors inform us in the preface, based largely upon the article Mammalin, together with forty shorter articles, written by Prof Flower for the minth edition of the "Encyclopedia Biratanica". Certain other articles by Dr. Dobson and Dr. St. George Mivart have also been made use of. The illustrations, most of which are admirable, are chiefly those prepared for the "Encyclopedia." but many have been added Mr. Oldfield Thomas, of the British Museum, the sassisted the authors in special matters. To Mr. Lydekter fell the task of arranging the various articles made use of in proper sequence filling up gaps and adding new matter, a large amount of which treats of the extract forms.

The book resulting from this process is undoubtedly now which will be found interesting and useful by ail students of soology. There is a great deal in it which is worth reading, esperially, so are the four introductory chapters on general anatomical characters, origin and classification of the Mammalia, and on geographical and geological distribution. Moreover, with regard to important animals such as the lones, sheep, goat, jug, a great deal of accurate information of varied character is given. The whiles are, so we should expect, treated given in the state of the stat

It should, however, be clearly understood that the book is not and does not profess to be a complete work of reference on the Mammalia. The references to extinct groups are exceedingly scanty, and whilst they serve to stimulate the reader's desire for further information, do not, as a rule, furnish him with the titles of original works in which such information is to be found. The bulk of the work Cousists of chapters treating of the orders of Mammalia in systematic sequence, and there is no doubt that, both for the general reader and for the more technical zoologist, they form a mine of valuable information well up to date, and as a rule well set forth by the aid of illustrations As an example of the latter, I may refer to the excellent woodcuts of the skull of Tritylodon from the Trias of South Africa, and of various lower jaws illustrating the section on Mesozoic Mammalia, but additional figures of this most important and little known series of forms would have been welcome, and one reads with unferened disappointment the declaration that "it would be beyond the scope of the present work to describe in detail, or even to mention the names of, all the members of this group"

There are one or two points of general interest in the earlier chapters to which I may briefly call attention

The view originally formulated by Huxley, that in looking among Vertebrates for the progenitors of the Mamalia we must pass over all known forms of birds and reptiles and go right down to the Amphibia, is maintained

by the authors, whist reconcining this conclusion with Prof Cope's important observations on the remarkable resemblances which obtain between the extinct reptiles known as Theoromorpha (Therodonia, Pelycosaura) and the Monotreme Mammals Recent observations have shown such an intuinate connection between the South African Theromorpha and the Labyrinthodoni Amphibans that there can, our authors maintain, be no hesitation in regarding the one group as the direct descendant of the other and "we may probably regard the Mammalia is having originated from the same ancestral stock at the time the Amphiban tripe was assing into the Rootlian."

In reference to classification, the authors observe that it is a simple matter to indicate natural groups, such as orders and sub-orders, among existing Mammals, but when we pass to the extinct world all is changed. New forms are discovered which cannot be placed within any of the existing divisions "Our present divisions and terminology are," say I'rof Flower and Mr Lydekker, "no longer sufficient for the purpose [of a classification which shall embrace extinct forms], and some other method will have to be invented to show the complex relationships existing between different animal forms when viewed as a whole" Apparently the authors mein, by the last five words of this sentence, "when all are viewed together" The necessity for drawing up lists and catalogues in a linear series is deplored. but unhappily no attempt is made by the authors to grapple with the difficulty. A classification of the Mammalia in a linear series is given as far as families, and the names of groups containing only extinct forms are printed in special black type I should have been very glad to see some attempt to set forth in the form of genealogical trees the senior author's views on the genetic relationships of this confessedly artificial linear series I cannot admit that the division of the Mammalia into three groups-Prototheria, Metatheria, and Eutheria, or, as De Blainville called them, Ornithodelphia, Didelphia, and Monodelphia -- expresses a natural fact, if these three groups are regarded as equipollent, and as succeeding one another as three "grades" of evolution. It is not difficult to come nearer to an expression of actual genealogical relations than this lt appears preferable to divide the Mammalia primarily into two grades (A) the Monotrema, and (B) the Ditrema, only so do we give expression to the wide gap by which the archaic characteristics of the Monotremes separate them from all other Mammals. Then we can divide the Ditrema-not into two successive grades of structure -but into two diverging branches, viz Branch a Marsupialia, and Branch & Placentalia Of the Placentalia our authors say that their affinities with one another are so complex that it is impossible to arrange them serially with any regard to natural affinities. They might, however, it seems to me, embody their own conclusions in classificatory form, and divide the Placentalia into four diverging sub-branches, the chief being (a) the Typidentata, the three others being (b) the Edentata, (c) the Cetacea, and (d) the Sirenia The group which I call Typidentata our authors actually define, though they do not name it and use it as would surely be convenient. They say, "The remaining Eutherian Manimals [1 e Placentals after exclusion of Edentata, Cetacea, and Sirema] are clearly united by the characters of their teeth, being all heterodont and diphyodont with their dental system reducible to a common formula." I have for many years made use in my lectures of the classification of Mammalia above indicated which may be summarized thus :-

> Class MAMMALIA. Grade A MONOTREMA. Grade B DITREMA. Sub-bi ř š Š. ۵. Ą Polyprotod Typidentat

Sub-br. 6.

Diprotodonta

No doubt it is difficult, even with the use of the additional terms "grade," "branch," and "sub-branch," to set forth the relations to one another of the known orders and sub-orders of Typidentata: but the attempt must be made, and there are materials in the present work for gathering some indications of the form which such a tentative pedigree would take had the authors gone so far as to formulate it.

In the chapter on geographical distribution, the six zoological regions of the globe proposed by Dr Sciater in 1857 are accepted But here, as in regard to the treatment of morphological groups, it seems that a primary grouping of the divisions recognized might with advantage be introduced, which would give a truer expression of the historic relations of existing land surfaces than that adopted Reference is made to the proposed elevation of New Zealand into a primary region, but would not the truth be more nearly expressed by separating New Zealand and the rest of the world first of all, as Atheriogæa and Theriogaea? Should not the Australian region next be separated from the rest of Theriogæa? Theriogæa would then be divided into the Ferra Marsupiahum and the Terra Placentalium (without prejudice to the recognition of the occurrence of a limited number of Marsupials in the latter) The Terra Placentalium includes the five regions called by Sciater Palæarctic, Nearctic, Neotropical, Ethiopian, and Indian. The authors of the present work mention Dr Heilprin's opinion that the Palæarctic and Nearctic regions should be united and called the Holarctic region. But they do not adopt this opinion, nor refer to Huxley's proposal to term this same area Arctogæa, and his suggestive speculations as to the successive connections of the three great peninsulas (as they are at present)-the Neotropical, the Ethiopian, and the Indian-with this northern land surface

I have ventured to cite one or two instances in which the methods of classification adopted in the "Study of Mammalia" appear to be open to improvement I trust that I may without offence express a doubt as to what precisely is the meaning of the last part of the following passage :--

"The researches of palæontologists, founded upon NO. 1128, VOL. 44]

extinct forms, have shown that, in many natural groups of Mammals, if not in all, the brain has increased in size and also in complexity of surface foldings with the advance of time, indicating in this, as in so many other respects, a gradual progress from a lower to a higher type of development."

I confess that I do not understand what this "lower" and " higher type of development" refer to. The remarkable thing about the small brains of extinct Ungulata is that, whilst they differ enormously in relative size and in the low development of other features from the brains of living Ungulates, their possessors exhibited no corresponding difference of skeletal structure ; so that it appears that the brain has had an independent evolution. advancing in size and complexity from the initial phase of the primitive Ungulate far further than has the general body-structure. The gap in respect of brain between man and the highest ages, accompanied as it is by mere trivial differences of bodily structure, appears to be a less marked case of the same general phenomenon. We may say that the brain in the one case is in a lower and in the other in a higher stage of development; but whether the authors mean this merely, or that the whole animal has passed "from a lower to a higher type of development," and to what kind of morphological doctrine that phraseology belongs, are matters which do not immediately explain themselves.

The only way to write of so large, so comprehensive, and so authoritative a work as the present, is to point out a few matters for discussion which a rapid review of its pages suggests. Such indications of topics on which one would like to know more from the authors of a book of this kind are not fault-findings, but samples of the interest which it awakens in a sympathetic reader.

È RAY LANKESTER

FORTY YEARS IN A MOORLAND PARISH

Forty Years in a Moorland Parish By the Rev 1. C Atkinson, D.C.L. (London Macmillan and Co. 1801.)

"HE moorland parish of which Dr Atkinson writes is the parish of Danby, which lies among the Cleveland Hills, some miles inland from Whitby. Here he has worked as a clergyman for forty-five years. To a man of narrow sympathies and little intellectual curiosity the position might have been trying enough; but in the life of the people, in the aspects of Nature, and in local problems appealing to the antiquary and the historian, Dr. Atkinson has found sources of interest which have never lost their charm. In the present volume he records some reminiscences of the pursuits which have occupied him, and of the impressions which have been made upon him, during all these years, and a very fascinating record it is. He not only has powers of keen and accurate observation, but carries on his researches in a thoroughly scientific spirit; and he is a master of the difficult art of stating problems in a manner that secures attention while, they are being gradually solved. His immediate subject is Danby; but if the author bad never raised his eyes to look further afield, his readers might soon have felt that he had told them studies of casts of the interior of the cranial cavity of about as much as they wished to know. Facts relating to a particular locality can never be really understood unless they are brought into connection with kindred facts in other parts of the world. This is constantly borne in mind by Dr. Atkinson, and his ample learning enables him to apply the principle in many different ways; so that, when he is talking about Danby, he is often talking at the same time about wide regions of the British Islands, and even about stages of culture through which the greater part of the human race has passed

One of the most interesting of the sections into which the book is divided is the one headed "Antiquarian." In Danby, as in Cleveland generally, there are many prehistoric burnal-mounds, and a large number of these he has carefully excavated. The only traces of bronze he has discovered are " a few mouldering fragments of very thin plate, found with the unprotected bones of a cremated body, and not sufficient to fill a very small pill-box half an inch in diameter." Nevertheless, the contents of the larger "houes" prove conclusively that they belong to the Bronze Age, and Dr. Atkinson is of opinion that they date from the later part of the period. He has found many vases of the Bronze Age type, some jet beads, two polished axe-hammers, various bone pins, arrowheads and other objects of flint; and by far the larger proportion of these treasures may now be studied, along with similar treasures recovered elsewhere, in the British Museum Dr Atkinson tells with great spirit the story of the more memorable of his explorations; and he has much that is amusing to say about the wonder excited among his rustic neighbours by what seem to them his mysterious proceedings, and about the interest aroused in the minds of those whom he has from time to time induced to help him. Across the ridges between which he the dales of the district are ancient earthworks, all of which " are defensive against attack from the south, and in no other direction whatever." Of these dykes, which seem to be of the same period as the burial-mounds, Dr. Atkinson gives a full and lucid account, and he offers some suggestive hints as to their relation to other old fortifications in the neighbourhood He has also an excellent chapter on various pits which have often been described as the remains of "British settlements" There can be little doubt, as he shows, that in reality these pits are the remains of early mining excavations

Another valuable part of the book is devoted to folklore The belief in witches has not even yet wholly died out in Cleveland; and forty years ago it was still a more or less potent factor in the lives of the people. The author gives some curious instances of the power formerly attributed to witches, and of the means by which their devices were supposed to be thwarted by the "wise men" of the district. He suggests that witches may not always have been mere impostors, but that in some cases they may have been able to exercise the kind of influence to which the phenomena of hypnotism are beheved to be due. Even more interesting than the traces of faith in witchcraft are the survivals of "fairy," "dwarf," and "Hob" notions. According to a tale told to Dr. Atkinson by an old woman, there was a farm in Glaisdale where Hob, so long as he was not spied upon, did much excellent work at night. At last some one was curious enough to watch him, and it was thought he would be all the better for "something to hap hissel' wiv." Accord-

ingly a coarse shirt, with a belt or girdle to confine it round his middle, was made for him, and left in the barn where he worked. When he found the gift, Hob broke out in the following couplet.

"Gin Hob mun hae nowglit but a hardin' hamp, He'll coom nae mair, nowther to berry nor stamp."

Dr Atkinson was delighted with this couplet, for it preserves three words which had become obsolete forty years ago, and two of which-"berry" and "hamp"had no actual meaning to the speaker. "Stamp" was the word for "the action of knocking off the awns of the barley previously to threshing it, according to the old practice" "Berry," meaning to thresh, he had been "looking and inquiring for, for years, and looking and inquiring in vain" As to "hamp," he had "never had any reason to suppose that it had once been a constituent part of the current Cleveland folk-speech" The hamp was a kind of smock-frock, gathered in about the middle and falling below the knee, and was at one time the characteristic garment of the English peasant The word "seems to be clearly Old Danish in form and origin "

There are several chapters which will give pleasure to students of geology and ornithology, and in his notes on weddings, burnals, the harvest-home, and holy wells, the author displays much ingenuity in detecting survivals of what were in past times wide-spread customs. In the interpretation of old historical documents, and in the purely descriptive parts of the book, he is equally successful. Some readers, finding so many things to lure them on from the beginning of the work to the end, may be dissipated to the historical production of the work of the survival su

OUR BOOK SHELF.

Anatomy, Physiology, Morphology, and Development of the Blowsky (Calliphora crythrocephala) Part II By B. Thompson Lowne, F.R.C.S., F.L.S., &c. (London R. H. Porter, 1891)

This general features of this study in insect anatomy have already been noted (NA 1028, vol Mills, 27). Part II. describes the exoskeleton in considerable detail, and contents many useful and elaborate figures Plate v. and the accompanying explanations give the author's news upon the morphology of the mesc-thead. The pre-oral part he regards as developed from three bladder-like swellings, to which correspond three primary divisions of the cephalic nerve-centres. The post-oral part is supposed to arise by the fusion of three jaw-bearing segments. The terminal portion of the probosets as probably developed, according part of maxilia. The description of the mouth-parts is very full, and the figures are extremely wood.

The thoracic skeleton is also minutely described, perhaps over-minutely, seeing that, mour author's words, by a classification of the various sclentes indicative of their morphological significancies is not possible with our present knowledge. Other careful descriptions by special students show that it is easy to interpret the complex thoracic structures in a different way from that here adopted.

Excellent figures are given of the legs, feet, and wings,

and the description of the foot of the fly is of very special interest. The wing-joint is described with great care and thoroughness, in connection with the mechanics of

flight
Comparisons between insect and vertebrate structures are made with great boldness One example will probably astonish common-place morphologists observed that the femore-tibial part of the fiv's leg forms at first a mere lateral prominence, which is converted by segmentation and constriction into a bent knee, the upper part yielding the coxa and femur, the lower part the tibta. Mr. Lowne confirms this account, and illustrates it by figuring five stages (Fig. 34) Next he compares the lateral prominence to the exopodite of a biramous limb. Then he adopts Dr. Gaskell's suggestion that the limbs of an Arthropod may correspond to the visceral arches of a Vertebrate. In the following sentence we reach the chmax. "The double character of the embryonic appendages in the Crustacea, and in the maxillæ of insects, as well as in the thoracic limbs of the rudimentary fly-nymph, is certainly very suggestive of the double character of the pterygomaxillary arch, or even of the hyomandibular in vertebrates."

So much conscientious labour has been bestowed upon this treatise, and it is so useful to the student of insect anatomy, that it is a pity to see the text encumbered with discussions which, to avoid dogmatism, we will merely call extremely hazardous. Would it not be better to magnum opus free of doubtful matter?

When all deductions have been made, the book must

be counted a valuble addition to the literature of the

subject

Races and Peoples. Lectures on the Science of Ethno-graphy By Daniel G Brinton (New York N D. C. Hodges, 1890 Sold by Kegan Paul, Trench, Trubner, and Co)

THE lectures of which this book consists were delivered at the Academy of Natural Sciences, Philadelphia, early in 1890. They present a good general view of the lead-ing principles of ethnography, as these are understood by the author. He begins with a discussion of what he calls the physical and psychical elements of ethnography, next treats of the beginnings and subdivisions of races, then takes in order the divisions in which he arranges the various groups of mankind, and finally deals with problems relating to "acclimation," amalgamation, and the influence of civilization on savages, and offers some the innuence of civilization on savages, and offers some suggestions as to the destiny of races. The human species seems to him to include five races—the Eurafrican, the Austafrican, the American, and insular and littoral peoples. Each of these is subdivided into branches, stocks, and groups; and an effort is made to define the traits which, according to Dr Brinton, the members of each race have in common It is not always easy to understand the principle of his classification. The Eurafrican race, for instance, includes the following The Eurafrican race, for instance, includes the following groups: Libyans, Egyptians, East Africans, Arabans, Anyasanians, Chaldmans, Euskarians, Indo-Germanic or Celindic peoples, and peoples of the Caucasis These peoples are all white; and Dr. Britton thinks was peoples are all white; and Dr. Britton thinks was also say of them, "harr way, nose narrow." But the differences by which they are separated from one another trempts doubthful subcluse; was an experiency, dust it is not. tremely doubtful whether we are warranted in attributing to them a common origin, except in the wide sense in which a common origin is attributed to humanity generally. So long, however, as Dr. Brinton's classification is understood to be merely a convenient way of bringing together great masses of facts, it may be of considerable service to students. The book embodies the results of much careful research, and is written in a clear and vigorous style.

NO. 1128, VOL. 44]

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions ex-persed by his correspondents. Nather can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communication.]

Crystals of Platinum.

Since writing a note on this subject to Nature (vol. xiiii. p. 541) I have found that it is by no means requisite to use lopaz in order to obtain crystals of plannum from a ribbon of topar in order to obtain crystals of plantium from a riboto that that metal heated by a current. Thus the ribbon may be dusted over with quartz dust, and if the temperature be raised to that at which this is slowly melting (1430° C ahout), crystals of at writer that is slowly melting [1430° C about), crystals of plannum gaiher upon projecturing points on the quarts. Doubt-less the presence of fluorine will facilitate, as described in my former letter, the volalitation of the platinum, but there is little doubt that at a temperature some 300° below its melting-point (1730°; Y 1001e) there is a slow volalitation of the metal due either to heat pure and ample, or to this in conjunction with the presence of a current as in high vacua.

with the presence of a current as in high vacus.

To put the possibility of chemical action out of the question, I weighted a clean ribbon of pure platinum, g centimetres in length, and passed such a current through it, for 50 minutes, as raised it to nearly the melting-point of palladium (150°, Violle) from the melting-point of part (Afrye's tor Too' Feren s. Stockholm Forhands, Pal. 13, Halt 2, 1891) obtact crystals of paltamum formed by the action of chloring est upon plainamum formed by the action of chloring est upon plainamum formed the observations of the memberature. The figures illustrating has paged deposit crystals smaller to three obstance by the present of 100°.

Physical Laboratory, Trinity College, Duhlin,

Porpoises in the Victoria Nyanza,

In Dr Carl Peters's "New Light on Dark Africa," he speaks of "some large gray bellied porpoises tumbling about "in Lake Victoria Nyanza, "and rollicking in the tepid flood" (see p. 445). Yicioin a Yanna.

I should be glad to know whether there is any other animons, for the occurrence of a Cetacean in this lake. It is possible, but very improbable, as no Cetacean are known to occur in the Nile, or other African fresh waters, although there has been a report of the Manattee being found in the Shari, which runs into Lake Tohind (see Barth, "Ressen," ii p 280), and the Manattee Lake Tohind (see Barth, "Ressen," ii p 280), and the Manattee Tohind (see Barth, "Ressen," ii p 280).

The Zoological Station at Naples.

It is desirable that the names of any biologists who wish to make use of the British Association Table at the Naples Zoological Station, during the year commencing in September next, should be in the possession of the Committee before the meeting of the British Association at Cardiff

Intending applicants are therefore requested to send in their names, and a statement of the nature of the work they propose to undertake, before June 30, to me as Secretary to the Committee W. PERCY SLADEN 13 Hyde Park Gate, S. W., June 6,

A BRITISH INSTITUTE OF PREVENTIVE

ON Friday, June 5, Sir Michael Hicks-Beach received in one of the large rooms of the Victoria Hotel, on the ot the large rooms of the victoria riote, an unusually numerous and influential deputation on behalf of the British Institute of Preventive Medicine S. M. Michael Hicks-Beach was accompanied by Sir Henry Calcraft, K.C.B., Secretary to the Board of Trade, Mr. Courtenay Boyle, C.B., and Mr. Walter J. Howell.

Among the members of the deputation were the Duke of Westminster, the Earl of Feversham, Sir Frederick Abel. Sir F. Bramwell, Sir John Lubbock, Sir Benjamin Baker, Dr Farquharson, M.P., Sir William Thomson, Sır James Baın, Sır Joseph Fayrer, Sır Philip Magnus, Sır Jacob Wilson, Prof. Dewar, Sur Douglas Galton, Sır Acchibald Geite, Sır William Houldworth, M.P., Sır George Gunphy, Mr Haldame, O. C. Ray, Lankester, Prof. Norman Lockyer, Mr Blundell Maple, M.P., Sır Ceorge Gabrel Stokes, M.P., Sır George Gabrel Stokes, M.P., Sır George Gabrel Stokes, M.P., Sur George Gabrel Stokes, M.P., Port Mardon Sanderson, Sır Henry Tremma Wood, Prof Victor Horsley, Dr Armand Kuffer, Mr Prestiley, Grand Gabrel Stokes, M.P., Sur George Gabrel Stokes, M.P., Port Mardon Sanderson, Sır Henry Tremma Wood, Prof Victor Horsley, Dr Armand Kuffer, Mr Prestiley, Braynson, and other Scotches, the Royal, the Linnean, and other scientific Societies.

The following letters were read from Prof Tyndall and Prof Huxley .-" Hand Head, Haslemere, June 3, 1891.

"My DEAR SIR JOSEPH,—The battered remnant of four deadly assaults, I am still a prisoner in my bed Were I a free man, I should deem it a privilege to join your deputation to Sir Michael Hicks-Beach on June 5 I entirely sympathize with the movement

"Let me here record a small experience of my own "Let me here record a small experience of my own Last summer, while crossing from Dover to Calais on my way to the Alps, I noticed, huddled up in a corner of the steamer, a poor English boy He seemed loady and depressed, and I spoke to him "Where are you going, my boy? I asked 'To Paris,' was the reply 'And what are you going to do in Taris?' 'Well, sir, said he, 'I have been badly butten by a med dog,' and I am now on my way to Mr. Pasteur, who I hope will save

"The case prompted sad and bitter musings Here was wealthy England, with the amplest means at her disposal, with some of her ablest men ready to investigate and apply those some of her ablest med ready to investigate and apply those means, insansity forbidding such investigation, and compelling rescued from the most horrible of deaths. As I spoke to the did, the virtulent rable virus was probably already in his blood, and his chance of life depended on the promptness with which Pasteur's succeine could be introduced to compact and destroy that virus. Every hour lost in the collection of money for the boy's journey and in making arrangements with Pasteur for his reception-every hour lost in his transport from England to reception—every hour lost in his transport from England to France—was so much time given to the virulent virus to pursue its fatal work, and to ruin the chances of the boy's rescue This is the state of things to which we in England are forced to submit; this is the condition to which we are reduced, through the deference paid by English statesmen to a noisy and an ignorant

"But while the investigation and treatment of hydrophobia "But while the investigation and treatment of hydrophobas confer immoral honour on Pasteur, this malady is but a small item in the array of disorders now demanding investigation Suspected from time to time by men of geniss in the past, the fact that all communicable diseases are due to micro organisms, which increase and multiply after the manner of living things, has, in the opinion of our fair authorities, been now reduced to has, in the opinion of our next authorities, ocen now resuccess to demonstration. Vor proposed mixture is to be devoted to the investigation of such organisms—to the study, that is, of the science of bacteriology. In regard to questions of life and health, such an institution is the most pressing need of England at the present hour A good deal of the weary time which I have been forced to spend in bed during the last six months have been forced to spend in bed during the last six months. has been devoted to making myself acquainted with what is being done by the staff of the Hygienic Institute of Berlin, an institute of which the German auton may well be proud. I have occupied myself in drawing up an account of the receatly carried out in connection with the institute. In regard to our most fatal disorders, these researches will effect a revolutroon, not only in public knowledge, but also in the thoughts and practice of medical men It would, in my oplinon, be a lamentable mistake on the part of an English statesman to place himself in official antagonism to the eminent and illustrious men who on June 5 will advocate the founding of a similar institute in England

in England
"It is, I think, fortunate that you have in Sir Michael HicksBeach a stateman not likely to fall into the extravagances of
senumentalism. The overwhelming preponderance of English
intellect will be represented by the deputation. "Me may rest
saured of it that this preponderance will become more and more

conspicuous, until finally the misguided opponents of a true philanthropy will cease to engage the attention, much less enlist the sympathy, of the English people "Belleve me, dear Sir Joseph, most faithfully yours,

"JOHN TYNDALL

"Sir Joseph Lister, Bart.

" Hodeslea, Eastbourne, June 2, 1891 "DEAR SIR JOSEPH LISTER .- I am very sorry that I am

"DEAR SIN [OSEPH LISTER,—I am very sorry that I am unable to join your deputation on June 5.
"If I outld have been with you, I think I should have asked to be permitted to point out to the Frendent of the Board of I raide that medical science is not excepted from the rule which holis good for other branches of natural knowledge, and that it can be advanced only by reasoning based upon observation acquement, and constantly convolided by both, especially by the experiment, and constantly convolided by both, especially by the

"Further, that by working in this fashion a marvellous improvement of medical science has been effected during the last half-century, and that the harvest of what Bacon called 'fruits,' which is now waiting for the gatherer, might fully occupy half a dozen such institutes as that in which we are

interested.

"Starting from the unquestionable facts that the work we propose to undertake is of supreme public utility, and that the number and extent of the problems of pathology are enormously number and extent of the provients of partology are enormously great in proportion to any existing means of dealing with them, I should have ventured to ask why we should be refused the only privilege we seek—namely, that official recognition by the Board of Irade which will afford the institute security against

the possible misuse of its funds in future?
"No doubt, however, all these points will be much more effectually put by yourself and other members of the deputation. "I am yours very faithfully,

"Sir Joseph Lister, Bart , F R S."

Sir Henry Roscoe, M P, in introducing the deputation, said that it represented not only the whole body of medical men in this country, but also, without exception, all the scientific elements amongst scientific men, and also a large number of others who were interested from the national point of view in the establishment of an institute of preventive medicine for this country, and for which it was proposed to obtain incorpora-tion under the Board of Trade He need not go into the ques-tion as to the national importance of an institution of this kind There was no civilized country in Europe, and scarcely anywhere else, in which this subject had not awakeaed the interest where ease, in which the abolect had not awakeed the interest and claimed the attention, not only of the scientific men, but also to a great extent of the Governments of those countries What they asked was that Sr Michael Hicks-Beach would be good enough to enable them to found and to carry on a British Institute of Preventive Medicine, analogous and of a similar Institute of Preventive Medicine, anatogous and of France, Germany, form to those great institutes which existed in France, Germany, They were form to those great institutes which existed in France, Germany, Rissua, and in a great aumber of other countries. They were sorry to find that the object which they had in view and 'b. request that they made to Sir Michael had not met altogether with the success which they had hoped. They learnt from the answer which he had given to Major Rasch in the House of Commons that the erfensal to grant what they requested was based on objections received by the Board of Trade. They merely asked that the institution should be registered under the Limited Company Act, with the omission of the word "limited," Limited Company Act, with the omission of the word "limited," an order to imprise the public with the fact that the institute was not established for the purpose of gain, but jurily for the fact that a part of the a rok would include experiments on animals. In reply to this they had the opinion of counsel that the Board of Trade had only to satisfy themselves that the object was charatable, and that the promoters were persons whose positions was a sufficient guarantee of the high character

of the proposed institute
Sir Joseph Lister said the niject of their deputation was to request Sir Michael Hicks-Beach to reconsider his decision, and request. Sir Michael Hicks-Beach to reconsider his decision, and to grant the lonce under the Board of Trade which was really, as a woold seem, almost essential to the property; if not indeed to the very ensattee, of the institute It was essential, in order that they night hold money in trust, that they should be incorporated. They had been promised a large sum of money, the receipt of which would be essentially dependent upon their incorporated as in dirthey were moreoprosted as a limited inhabity. company they would not be able to appeal to the public for funds with any success. In the first place, their institution would have a mercantile character, which would tend to repel sub-scribers; and they had the opinion of counsel that under such scribers; and they had the opinion of counsel that under such circumstances it would be in the power of the subcribers at any time to agree to have the natitute wound up and the funds divided amongsit themselves To appeal to the public for sub-scriptions, therefore, under these conditions would be absolutely hopeless. On the other hand, if he licence were granted there could be inserted by the Board of Trade a condition that the funds of the institute should be used only for scenatic and charitable objects, and in that way their position would be per-fectly secured. The only practical alternative, if it was still thought right to refuse their request, would be that they should be incorporated by Act of Pariament—a process which would involve very great loss of time and also very serious expense The importance of the object which they had at heart was one The unportance of the object which hey had at heart was one which he thought need hardly he much dwelt upon Pereentive medicine based upon bacteriology was a matter of comparative and every year and almost every week they were learning of new trumphs schleved in the discovery of the essential nature of discase and of the means of preventing such disease. He might be permitted pathaps to refer to one or two illustrations of the swate of the work carried on at such institutes both to man and to the lower animals The work such institutes but to manage to the loves animals and dogs done by M. Pasteur for the tescue of those bitten by mad dogs from the horrible death of rahies was bearing invaluable fruits It had been estimated that within four years at the Pasteur Institute 12,000 lives had been saved During the last six years Institute 12,000 ween and neen saved During the last my years 403 British subjects had been treated, and out of those 403 only seven had died. If they took into account the loss of time in-volved in making arrangements for going to Paris, and con-sidered also that the eyer or of M. Pasieur's treatment was to intercept the disease before it arrived a the vital organisms in the brain, they might anticipate a large amount of success if they had the means in this c unity of having the same treatment had the means in this c usity of having the same treatment carried out. From Germany had come the discovery of what was termed tubercle bacillus—that was to say, the micro-organ-ism which was the executal cause of tubercle, the greatest physical sourge that afflicted the human race. To establish that physical scourge that afficied the human race. To establish that that bacilius was really the essential cause of this disease in all its diverse forms required a large air uni of investigation such as could only be carried on in institutes like that which they desired to see established. That the institute would be of great benefit also with regard to disease of the lower animals might be seen from the discoveries made as to the cure of anthrax by M from the discoveries made as to the cure of antarax my m Pasteur, and as to the treatment of another affliction. Known as "quarter evil" by a scientist of Lyons Various bacteriological aboratories had been alreadly established in the British Islands, but it was universally allowed that none of those existing was in the least equal to a great institute such as they desired to see established. One proof that such was the case were researched. established One proof that such was the case was presented by continually to Paris or to Berlin for the superior selvantages continually to Paris or to Berlin for the superior advantages that they could obtain there. He ventured to think that the mass of educated opinion represented by the deputation was surely more deserving of attention than the views of those who, with whatever excellent intentions, had petitioned against their scheme. The truth was that objections, were made because the scheme. The truit was that objections were made because the petitioners objected alticyclient to the performance of experiments upon living animals, and not because they thought that there was already sufficient opportunity for work of this kind. If those petitioners knew how very small was the amount of suffering really tioners knew how very small was inc amount or supering really inflicted upon the animals in such an institute, and how scrupu-lous was the care taken to avoid all needles- pain, they would not (at least, the great majority of them would not) have made the opposition that they had made. He even doubted whether the opposition of their being likely to perform experiments upon living animals was one which the Board of Trade had any fair reason to occupy itself with. The licensing of places for the performance of such experiments, and the heening of individual experimenters had always rested with the Home Secretary.
Foreign institutions such as that which they desired to see established had been largely endowed by the Siste, and he did not relinquish the hope that our Government might at some future time see its way to give them substantial aid. But, however that might be, they ventured to hope that no department of this Government would oppose any unnecessary obtacle to an enterprise which had for its sole object the welfare of humanity, the

health of mankind and the lower animals, and the general

progress of the public weal.

Sir Lyon Playfair, M.P., said that experiments on living animals had been sanctioned by Parliament, which had intrusted animals had been sanctoned by Farliament, which had intrusted the Home Securitary to make unlitable restrictions for the carry-moted differently from those in foreign countries, which were being founded by the Sites, and the deputation only saked to be allowed to associate for a purpose recognized by Parliament, and with such restrictions as Sir Michael Hicks-Beach or the

and with such restrictions as Sir Michael Hicks-Beach of the Home Secretary though proper to Impose Prof. Dewar spoke of the importance of the proposed institute from a chemical point of view, and Dr. Ray Lankester and Sir James Cnehton Browne also spoke.

Sir M Hicks-Beach, in reply, said:—I hope that it is not through any fault of mine that those who have arranged for this through any fault of mine that those who have arranged for this deputation have not come to me in the ordinary numbers of a summarised of the control of the present had come to me saying what has been said to-day, and authorized to speak on behalf of all of you, I can assure you that authorized to speak on benair of all of you, I can assure you that I should have attached as much weight to their arguments as I can do now But, of course, I accept your presence here as a strong testimony to the great interest that you feel in this subject I am sorry to confers to have differed from so many ject I am sorry to confess to have differed from so many gentlemen of such enuments as those who have supported this novement, and to have found myself unable to grant the appli-mission to tegister the Association without the siddition of the word "limited". It is only due to you that I should explain, as shortly as I can the reasons which induce me to arrive at that decision. Now, the section of the Act of 1857, under which you are five to set, lays down two preliminary requirements which must be proved to the satisfaction of the Board of Trade—first, that the Association shall be formed for one of several purposes, such as, for instance, that of promoting science, or some other useful object, secondly, that the profits or income or some other useful object. A secondly, that the promis or income will be applied to promote the objects of the Association, and that the payment of dividends will be prohibited. Now, I will assume that you have complict with both these requirements. I say nothing to the contrary. But the proof of such compliance does not, in my opinion, compel the Board of Trade to act on the section. Something has been said to day to the effect that you have obtained counsel's opinion that it does compel the Board of Trade so to act. I have taken another view—I admit without legal advice If you will place before me the opinion upon which your view is based, of course I shall very carefully consider it, and myself obtain legal advice upon that point, consider it, and myself obtain legal store upon that point, because I rew it as an important point, as you will see from what I am going to say. I have considered, as I said, that the section of the Act only empowers the Board of Trade to act, and leaves it to the Board of Trade to decide whether the conditions or explaintons should be imposed and inserted in the memorandum and articles of association. It therefore seems to me that the Board of Trade could hardly grant used a licence without expressing approval, by the mere last of the grant, of the Association to which it is granted. In your case I think I have been considered that the property of the property interpret Unisse 30 of your memorandum, I understands—Ann I also gathered from what has been said to-day—"that experiments on living animals calculated to give pain," to quote the words of the Act of Parlaments, are included among your objects; in one word, that vvinection would be part of your works. Now, this is a subject which the Legislature by the Cruelty to Animals Act, 1876, has placed under the control, not of the Board of Trade, but of the Home Office. By that Act, as you know, vissection is made illegal except by licence from the Home Office, and under the most stringest regulations, including Inspection by inspectors of the Home Office. I assume that when you had established this institution, supposing my locance were granted, an application would be made to the

Home Office for a licence or licences for wivection on the premue of the institute for some one or more of its members. It seems to me that the Home Secretary would have fair ground composition and an account of the composition of the compos

been expressed I shall be glad to receive.

Sir John Lebbock, in moving a vote of thanks to Sir Michael Hicka-Beach, said has Sir Henry Roscoe had authorneen him of the state of Trade. Virturection was after all a very small part of the question before them, unless, indeed, virusction was to be understood as applying to the indeed, the state of the state

The President—I ought to mention that any of the precedents which have been mentioned I should like to have placed before me.

The deputation then withdrew.

EARTH-CURRENTS AND THE ELECTRIC RAILWAY

A WELL-MAKED case of interference with the earth-currents recorded at the Royal Observatory, Greenwich, due apparently to the working of the new Electric Railway, having recent prove to esperienced, of which some account might prove to electricians, the Astronomer-Royal has kindly allowed me to communicate for publication in Natural some particulars in regard thereto.

It is known that for many pears past a continuous photographic register of earth current has been maintained at the Royal Observatory There are verticated for one circuit the earth-plates are at Angerstein Wharf (A. W.), on the southern bank of the River Thames, near to Charlton, and at Lady. Well, Lewisham (I. W.); for the other circuit the earth-plates are on Blackheath (B.) at the south end of the North Kent Railway tunnel, and at the North Kent Railway tunnel, and the North Kent Railway tunnel on of the North Kent and Greenwich lines. The earth connection is in each and Greenwich lines. The earth connection is in each acts made by an undependent cropper plate; these plates

are used only for the earth-current lines, no other wires being attached thereto. From the AW earth-plate the wire passes by the South-Eastern Railway lines to the Greenwich Station, thence underground to the Royal Observatory recording apparatus, returning underground to the Greenwich Station, and thence by the railway to the earth-plate at L. W. Similarly for the Blackheath-between the L. W. Similarly for the Blackheath-between the AW and I. W. earth-plates at 3, miles, and between the B and N. K. E. earth-plates about 24 miles. The azimuth of the AW—L. W. line, reckoning from magnetic north towards east, is 50°; the azimuth of the AW—L. W. line, reckoning from magnetic north towards west, is 46°. Registration is effected in the usual way. In which carries a small mirror, on this the light from a fixed gas-lamp falls, and, reflected therefron, finally reaches the revolving cylinder as a small mirror, on this the light from a fixed gas-lamp falls, and, reflected therefron, finally reaches the revolving cylinder as a small grot of light

Some few particular's concerning earth-current motions generally may perhaps be given It has been found that all cases of disturbance of the magnets are according to the control of the control of the magnets ever accura without corresponding active earth-currents, as may be seen by the plates (copies of the various registers) given in the several Greenwich volumes since the year 18's. On days on which the ordinary disturbed change, earth-currents are very feeble

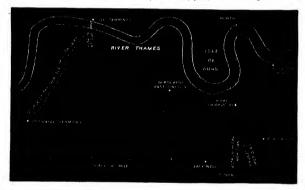
may devote a few words to the description of a previous case in which the interference was much less marked in any devote a few words to the description of a previous case in which the interference was much less marked in character, although, with some intermissions, otherwise very persistent. Some five years or more ago it was remarked, in the AW – LW register, that at one part of the day a slight dislocation of the trace occurred, in no case midicating a change of potential of more than or taken middle of the control of the

We now come to the recent much more serious case of interference. Towards the end of last year anomalous appearances began to be observed in both of the earthcurrent registers, not continuously but in a somewhat irregular manner Now, however, for some months past, these new interruptions have settled down into a regular order What is perceived is that the interference in question, causing a continuous vibration of the registering needles, commences shortly before 7h in the morning, goes on all through the day, terminating shortly after 1 th, goes on an universal months on in the evening. This went on for several months on week-days only, ceasing on Sundays, nothing being seen after 11h p.m. on Saturday, until 7h am on Monday, But on Sunday, April 5, and on every succeeding Sunday. But on Sunday, April 5, and on every succeeding Sunday. to the present time, the interference has been experienced also on a portion of the Sunday, commencing at about 1h pm, and terminating usually at 10h pm. or shortly afterwards. Various experiments were made with the view of discovering the cause of these anomalous appearances, but without definite result. Quite recently, Mr Leonard, the telegraphic superintendent of the South-Eastern Railway, to whom the Observatory is much indebted for considerable assistance in many matters connected with the earth-current work, was led to suggest

that the exceptional appearances were most probably due to the influence of the new Electric Railway. three miles in length, and having terminal stations in the City and at Stockwell. A comparison being made be-tween the observed times of interference with the earthcurrent registers, and the published times of running of the Electric Railway trains, it was found that these were simultaneous Further, in the early part of the year, during the period in which the earth-current registers were free from interference on Sunday, there were correspondingly no Sunday trains But on Sunday, April 5, it appears that trains commenced to run on Sunday afternoon, the same day that Sunday inter-

The line of the Electric Railway runs from about north-east to south-west magnetic, or more accurately norm-east to south-west magnetic, of more accurately the azimuth of the line, reckoning from magnetic north towards east, is about 50°. The nearest earth-plate to the railway is the N.K.E.J plate, which is distant from the railway, in a perpendicular direction from it, about 2½ miles

The correspondence so far as the comparison goes is complete During the periods of interference the registering needles at the Observatory are in continual vibration.
Whether the impulses are in one direction only or in both directions, and what is their frequency, cannot be readily determined from the registers Eye observation of the ference was first noticed at Greenwich, and these Sunday needles may perhaps reveal something to us on these



afternoon trains have been since continued. The whole matter is better seen in the annexed tabular statement .-Times of interference with earth current registers at the Royal Observatory, Greenwich Train service on Electric Railway On week days On week days. From shortly before 7 First train from Stockwell 6 40 a.m

a m. until shortly after Last train from Stockwell 10 46 p m ,, City 10 58 p m City 11 pm. On Sundays, commencing On Sundays, commencing April 5 From about 1 pm. un-First train from Slockwell

til 10 p m. or shortly

afterwards

ast train from Stockwell 15 pm 930pm City 9 30 pm. THE ANNUAL VISITATION OF THE ROYAL

City

OBSERVATORY. THE Report presented by the Astronomer-Royal this year is of more than usual interest. The first part deals with proposed new buildings.

It has been decided that the museum or storehouse for NO. 1128, VOL. 44]

points. The abnormal excursions of the needles indicate a change of potential varying from a small fraction of a wolt to perhaps the one-third of a volt or more When any marked earth-current action arises, the interference becomes in some degree neutralized, and less marked in character

It was found in the course of previous experiments, that when, instead of employing the complete AW-LW. circuit, the A.W branch only was allowed to register, by circuit, the Arv orante only was anowed to register, by putting the wire to earth at Greenwich, the amplitude of vibration of the needle was not perceptibly changed, neither was it changed when the LW branch only was allowed to register Gorrespondingly, when the B branch alone of the B-N K E.J. circuit was allowed to register, the vibration was much diminished, whist with the N K.E.J. branch alone registering it was much increased
William Ellis.

portable instruments and apparatus should be built so as portaine instruments and apparatus should be built so as to form the central octagon of a future cruciform struc-ture in the South Ground, which would accommodate the physical branch of the Observatory, and would carry the Lassell equatorial and dome at such a height above the ground that the neighbouring trees would not interfere with the effective use of the instrument. The building for the Museum was commenced at the beginning of March. In consequence of a recent decision of the Admiralty to largely increase the number of chronometers and deck watches for the Navy, additional accommodation for chronometers is required immediately, the space in the present chronometer room being

diately, the space in the present chronometer room being insufficient even for existing requirements.

In other directions the difficulty of providing in the existing Observatory buildings for the accommodation of the increasing staff and of the accumulating material is severely felt, and it is very desirable that the pressure on the space available should now be relieved by means of a comprehensive scheme, which would supply a suitable fireproof brick building to replace the wooden sheds and huts which now disfigure the Observatory grounds, and to provide for the expansion which has taken place in late

to provide for the expansion which has taken place in late years, and which may be expected to continue in the future. To provide for the efficient working of the 28 men refractor about to be mounted on the south-east equatorial, the Admirally have authorized the construction of a new iron-framed dome, 36 feet in diameter, to be erected on the south-east tower in place of the existing wooden drum, which, as mentioned in the last Report, has been so much strained in the course of thirty years, that there is great difficulty in turning it sattempt was made to render the existing dome more serviceable by bolting the framework together more thoroughly, and by substituting properly turned spheres for the cannon-balls, but though the dome is not now liable to strick fast as formerly, it is still very difficult to turn, and cannot be considered serviceable. The new 36-foot dome, which is being constructed by Messrs. T Cooke and Sons, is of peculiar form, adapted to the conditions of the case, the diameter being greater than that of the tower on which it is erected.

A photographic telescope with 9 inch object glass by Grubb, and a prism of 9 inches diameter by Hilger, have been generously presented to the Royal Observatory by been generously presented to the Koyal Observatory or Sr Henry Thompson The telescope has been mounted on the Lassell telescope as a photoheliograph, to give sinch pictures of the sun, a carner awith Dallmeyer doublet (from photoheliograph No 4), and an exposing shutter, specially designed to give very short exposures, being attached to it

Six more electric hand lamps and an Ampère gauge (Sir W Thomson's) have been purchased

In view of the advantage resulting from the use of electric lighting for the photographic equatorial and for other instruments, the Astronomer-Royal considers it very desirable that an electric light installation should be provided for the Observatory, so that this method of lighting, which is specially adapted to the requirements of an observatory, may be applied to the instruments generally. The system now in use of charging storage cells from primary batteries, is necessarily extravagant, and it does not admit of the desired extension

With regard to the work done, the following statement shows the number of observations made with the transit-

circle in the year ending May 10, 1891 .-

Transits, the separate limbs being counted as separate observations
Determinations of collimation error 6036 307 Determinations of level error 390 5789 Circle observations
Determinations of nadir point (included in the number of circle observations Reflection observations of stars (similarly included)

For determining the variation of personal equation with the magnitude of the star, 324 transits, not included in the above, have been observed. The apparent magnitudes of the stars are altered by placing a wire gauze screen in front of the object-glass of the telescope, and part of a transit is observed with clear aperture, part with obscured. The comparison of the two results gives

NO. 1128, VOL. 447

the difference of personal equation for a definite change of magnitude. It appears that all the four regular ob-servers record the times of faint stars later than bright,

the difference per magnitude being about o' ois Altazimuth - The total number of observations made in the year ending May 10, 1801, is as follows

Azimuths of the moon and star	5		253
Azımutha of Mark I			123
Azimuths of Mark II			193
Zenuh distances of the moon			118
Zenuh distances of Mark 1			124
Zenlth distances of Mark II			188

Reflex Zenith Tube -Since the date of the last Report, 14 double observations of y Draconis have been made and completely reduced to the end of 1800 M Lowy's recent work seems to show that the determination of the constant of aberration with this instrument is more trustworthy than had been supposed, though the circumstance that the observations give a negative parallax for y Draconis suggests that there is some unexplained source of error

Sir H Grubb reports that the object-glass and tube of the 28-inch refractor are now practically ready for mounting; but the Astronomer-Royal proposes to delay this operation until the completion of the new dome on the south-east tower mentioned in the first section of this Report

Work with the 13-inch photographic refractor was seriously delayed by the accident to the driving-clock, andr later, by the illness of Mr. Criswick, but 81 stellar photographs have been taken, all of which must be re-garded as more or less experimental Ferrous oxalate garacu as more or less experimental. Ferrous ovalate development was used throughout, and all the plates were photographically impressed with the reveau kindly supplied by Prof. Vogel. The exposures have varied from a few seconds to about an hour; and trails have been a few seconds to about an nour; and trains have occur taken both on the equator and near the pole to test the adjustment for orientation Several different kinds of plates have been used, including Cramer, Seed, Paget, Star, Mawson and Swan, and Ilford; and on the whole the choice seems to lie between the Star and the Ilford plates

Spectroscopic and Photographic Observations - For determination of motions of approach or recession of stars, 286 measures have been made of the displacement of the F line in the spectra of 31 stars, and 14 of the δ line in the spectra of 6 stars, besides comparisons with the spectra of Mars, the moon, the sun, or the sky, as a check on the general accuracy of the results. The series of observations with the 123-inch refractor is now practically completed, and the results are under discussion An examination of those for the 21 stars most frequently observed shows that there is a systematic error depending on the hour angle, thus necessitating a correction for the position of the spectroscope at the observation

In the year ending May 10, 1891, photographs of the sun have been taken at Greenwich on 224 days, and of these, 483 have been selected for preservation, besides 18 photographs with double images of the sun for determination of zero of position

Magnetic Observations - The following are the principal results for the magnetic elements for 1800 -

17° 28'6 W 3 9546 (in British units). 1 8234 (in metric units) Mean horizontal force (67 21 19 (by 9 inch needles) 67 22 53 (by 6-inch needles) 67 24 24 (by 3-inch needles) Mean dip

Mean declination

Meteorological Observations .- The continuous registration of meteorological phenomena has been maintained without interruption, except for four days in February when the old thermograph and shed in the magnetic ground were dismounted, and the new thermograph and shed were transferred from the South Ground to the position formerly occupied by the old instrument, to make way for the new buildings in the South Ground

The mean temperature of the year 1890 was 48°6, being 0°6 below the average of the preceding 49 years. The highest air temperature in the shade was 82°8 on August 5, and the lowest 13°1 on March 4 This latter is the lowest temperature registered in March since 1841. being the same us that recorded on March 13, 1845. The mean monthly temperature in 1890 was below the average in all months excepting January, March, May, and Sept-ember In December it was below the average by 10°0, and in January above by 5° 2

The mean daily motion of the air in 1890 was 272 miles, being 10 miles below the average of the preceding 23 years The greatest daily motion was 837 miles on January 26, and the least 32 miles on August 6 The greatest pressure registered was 14 5 pounds on the

square foot on January 26.

During the year 1890 Osler's anemometer showed an excess of about three revolutions of the vane in the

excess of about three revolutions of the vane in the positive direction N, E., S, W, N, excluding the turnings which are evidently accidental The number of hours of bright sunshine recorded during 1890 by the Campbell-Stokes sunshine instrument was 1255, which is about 35 hours below the average of was 1255, which is about 35 hours below the average or the preceding 13 years, after making allowance for difference of the indications with the Campbell and Campbell-Stokes instruments respectively. The aggre-gate number of hours during which the sun was above the horizon was 4454, so that the mean proportion of sunshine for the year was 0'282, constant sunshine being

represented by 1

represented by 1
The rainfall in 1890 was 21 9 inches, being 27 inches below the average of the preceding 49 years.
The winter of 1890-91 was remarkable for a long period of exceptionally cold weather which commenced on November 25, 1890. From this day till January 22

the mean temperature on every day except January 13 was below the average The temperature was conwas below the average was below the average. The temperature was con-tinuously below 32° on November 27, 28, December 10 to 19, 22, 23, 25, 28 to 30, January 2, 6 to 8, 10, 11, 17 to 19. The greatest defects from the average of 20 years were on November 28 (-19° 1), December 22 (-20° 7), and January 10 (-19° 3). The lowest temperatures 7e, and January 10 (-19° 3). corded during the three months were 18° 3 on November 28, 13° 4 on December 22, and 12° 0 on January 10 The mean temperature of December 1890 was 29° 8, or 10° 0 below the average of the preceding 49 years, the coldest December on record since 1841 previous to 1890 being that of 1879, whose mean temperature was 32' 4 In this same month. December 1800, only 2"4 of sunshine were recorded.

Chronometers, Time Signals, and Longitude Operations -- The number of chronometers and deck watches now being tested at the Observatory is 169 (113 box chronometers, 20 pocket chronometers, and 36 deck watches). The annual competitive trial of chronometers commences on July 4, and the trial of deck watches on October 24.

The time-balls at Greenwich, Deal, and Devonport are next referred to.

The reductions for the longitude Paris-Greenwich are now completed and ready for publication In reference to the discrepancy between the results of the French and English observers, mentioned in the last Report, Commandant Defforges visited Greenwich in June 1890, and went carefully through the reductions with Mr Turner and Mr. Lewis No mistake was found in the work, but several questions of some importance were raised. The results of the discussion and of subsequent correspond-ence are summed up in two papers by Mr Turner and one by Colonel Bassot and Commandant Defforges in the Monthly Notices of the Royal Astronomical Society, vol. li. pp 155, 407, and 413 respectively. As the matter of longitude between the Greenwich transit-circle and Cassin's meridian is 9m 20 86, while the French result Cassin's merician is 9" 20 so, while the French result (not yet published) is about 0"15 greater, a discordance which, though only about half of that found in the preliminary discussion, is still so large, that there seems to be no alternative but to repeat the work with special precau-

no alternative but to repeat the work will appecial precuations suggested by the experience gained.

The proposal to determine the longitude of Montreal as the base station for the Goodetic Survey having been sanctioned by the Admirally last December, arrangements have been made in concert with Frof. McLood, of the McGill College Observatory, Montreal, for a determination of the longitudes Montreal-Canso-Waterville-Greenwich, the termini of the cable, Canso and Waterville, being occupied as longitude and not merely as transmitting stations, a course which seems advisable in view of the great geodetic importance of these points The necessary funds have been voted, and the Com-mercial Cable Company have generously granted the use of their cable

The determination of the longitude of Washington has

been deferred for the present

During the past year, Lieutenants Heming, Monro, and Smyth, R.N., and Captain Haynes, R.E., have at various times been instructed in transit-observing. Mr S Hirayama, of the Tokio Observatory, was at work for some weeks studying the general organization of the Observatory

THE CLASSIFICATION OF THE TUNICATA IN RELATION TO EVOLUTION.

THE detailed classification of the Tunicata, and especially of the so-called "Compound Ascidians," has usually been found a matter of special difficulty by systematists, and each successive investigator has discovered grounds for modifying in important respects the grouping of genera and families established by his predecessors. A glance at the systems of Giard, Della Valle, von Drasche, and Lahille, all of recent date (re. post-Dar-winian, and since the introduction of modern methods and the recognition of the Tunicata as Chordata), shows the notable want of agreement between competent au-thorities. There is probably a special reason for this exceptional diversity of opinion, and I believe the cause is to be found in the course of evolution or phylogeny of the group, and especially in the complex relations be-tween the Compound forms and the other Tunicata.

In fact, if the matter be regarded from the point of view of the consistent evolutionist, the special difficulties vanish, the complicated relationships between groups vanish, the complicated relationships between groups (which can only be represented by dendritte diagrams, or even in some cases by networks) become explicable and natural, the great diversity in value of the assemblages of forms known as "genera" and "species" is simply what would be evpected, and the differences between the various classificatory systems (allowing for a few errors which have been corrected by later investigations) can be accounted for, and the conflicting opinions of the authors reconciled. But, on the other hand, if the subject be approached from the standpoint of the pure systematist, whose object is to divide and subdivide into clearly defined groups of approximately equal value, and to recognize only "good" genera and species, nothing but confusion results, it becomes practically impossible to distinguish and arrange naturally the groups of Simple and Compound Ascidians; and some of the most interesting and instructive points, such as the gradation of varieties into species and species into genera, and the individual variations in specific characters, are altogether lost sight of

These views were expressed partly in my Reports

on the Challenger Tunicata, but further work sincemosome very extensive collections from Australian seas
and on the Ascidians of our own coasts—has convinced
me that the only rational explanation of the protean
forms and labyrinthine intervelations of the protean
forms and labyrinthine species, genera, &c, have
not yet become markedly differentiated by the elimination
of intermediate forms, and where the animals are so much
at the mercy of their environment that a special presurge specific franzieres which are not useful), and where,
consequently, the relations between modification of structure and conditions of existence brought about by the
action of natural selection are exceptionally evident
of expects, and probably others with which I am not
concerned at present, can be, I think, satisfactorily explained. (1) the connection of the Simple with the
Compound Ascidians, and the classification of the latter,
(2) the value of some modifications of the branchial are,
(3) the numerous "species" of the genus Hestyrlius.

(1) If the attempt is made (as in most classifications) to regard the Compound Ascidians as a group distinct from the Ascidiæ Simplices, and forming either a parallel or a divergent line in regard to the latter, one meets at once with the serious difficulty that the Compound Ascidians show affinities with the Simple at several distinct points Three investigators approaching the Compound Ascidians after the previous study of certain Simple Ascidians -- say, the first fresh from Ciona, Esternascidia, and Clavelina, the second from Perophora, and the third from Myela and Polycus pa-could each make out a good case for the view that his new subjects were most closely connected with the genera he had just been working at could demonstrate the undoubted relations, in external form and in structure of branchial sac, between Clavelina and Chondrostachys, Colella and the other Distomidie, the second might point to the similarity (on which I personally lav no stress) of Perophora and the Botryllidae, in the relations of alimentary canal to branchial sac; and the third could show the close similarity between the Styeling and the Compound forms Synstyela, Goodsiria, and Choracocornus in nearly every detail of internal structure and all three would be partly right, and therefore unlikely to agree upon any one system of classification

But when the attempt is made seriously to form a conception of the past history or evolution of the forms in question, it becomes obvious that the Compound Ascidians are not a natural, but an artificial group That is, they are not the whole surviving descendants of a single group of ancestors, but are polyphyletic in origin, being derived from several distinct lines of ancestry which have arisen independently from different kinds of Simple Ascidians, and have since acquired the common characteristic of being able to re produce by gemmation so as to form compact colonies in which the members (ascidiozooids) are embedded in a common test or investing mass We know with as much certainty as we know anything in such phylogenetic inquiries that the ancestral Tunicates were not colonies, and that reproduction by gemmation was not a primitive character. This property has, then, been acquired secondarily by some ancestral Simple Ascidians, and may very possibly have been acquired more than once (though this is not at all necessary for my theory of the poly-phyletic origin). It follows from this view (which I have expressed before, but now feel more certain of from recent work), that if we are to retain the group Ascidiæ Compositie, or Synascidiæ, in our system, we must represent it as linked on to the Ascidiæ Simplices, at three points at least, and we must not attempt to arrange the families and genera in a series diverging from any one of these points alone, or if we do, we need not be surprised when we arrive at obviously unnatural arrangements which are in conflict with the classifications of our fellow-workers

On the other hand, we might abolish the group Ascidiæ Compositæ altogether as a sub-order of Ascidiacæ, on the ground that it is not a natural group (i e a compact set of descendants from a common ancestor—a single branch of

the genealogical tree)

But if we adopt this course with the Compound Ascidians. the same argument might be used in connection with other polyphyletic groups throughout the animal kingdom. They should all be broken up, it might be urged, as being artificial assemblages. And that would be a perfectly logical and definite position to take up, and one for which a good deal could be said, but before adopting it roologists should remember that it involves a loss as well as a gain If it gives "the system" a certain precision, and an advance of a step or two towards the goal of a completely natural classification, it at the same time destroys the recognition of characteristics which certain forms possess in common In whatever manner they have been obtained, there is no doubt that Compound Ascidians of the present day possess certain features by which they can be identified as Compound Ascidians, and this fact is surely worthy of recognition in our "system, My own opinion, then, is that the group Ascidic Com-posite should still be retained, but that its polyphyletic origin and multiple connection with the Ascidia Simplices should be carefully borne in mind when drawing

up any scheme of classification, or discussing affinities
(2) Some of the ideas noted above, and others to be discussed below, took definite form lately in reading a re-cently published memoir by M Fernand Lahille, in which, while giving a number of important original observations on the anatomy and bionomics of the Ascidians (and especially of the Compound forms) of the French coasts, the author introduces what I cannot help thinking in some respects an unfortunate attempt to remodel the classification of the Tunicata on lines which he communicated a few years ago to the French Association (Congrès de Loulouse, 1887), and now elaborates in detail. He regards the branchial sac as the most important organ in the Tunicata, and so it is in some respects, but that is not sufficient reason for regarding its modifications in structure as the sole characteristics of the primary groups For example, the Appendicularians, instead of being called Larvacea or Copelata, and characterized by the presence of a tail containing the urochord, are placed in a group "Atremata," defined by the absence of stigmata in the branchial sac. The openings in question (stigmata) are not even such important structures as the primary branchial clefts (gill-sitts), but are merely the secondary slits placing the cavity of the branchial sac in communication with the peribranchial or atrial cavity, and are of nothing like such high morphological value as the presence or absence of a urochord, and of the two prunitive atrio-pores, and the other well-known characteristics employed in former classifications as distinguishing the Appendiculariidae Some of the Thaliacea are placed by Lahille in a group (Hemitremata) of primary importance, by themselves, because they have the stigmata rudimentary or imperfectly formed, while the other Thaliacea are united with all the remaining Tunicata, because they are supposed to be alike in having complete stigmata.

Then, again, an altogether fictitious value is given by Labille to the presence of internal longitudinal bars in the branchial sac, especially since he shows (as had been done by former writers) that these bars develop as outgrowths

[&]quot; "Recherches sur les Tuniciers des Côtes de France " (Toulouse, 1890)

" Which, however, is not really the case " The apertures in the walks - the pranchal sur I Lahille's "Eutremats" are not always homologous retusture". In the genus Cultolius, for example, there are no true stigmatis

from the connecting ducts, and that intermediate conditions can be found in which the bars can neither be slight to be absent nor present. He describes this condition in his new species Perophora banyalenst, and it is also present in P viridit, Vernil, and in various other Simple Ascidians, as has been shown in the Challenger Reports

and elsewhere.

132

Such cases, although rather perplexing to the systematist, are perfectly natural from an evolutionist's point of view, and they certainly make one regard with some suspicion large groups founded upon any auch conclusions. The such consideration of the

Surely Lishille does not serously mean to contend that the internal longutudnal bars in the branchal as of the Botrylldae, Cynthidea, &c, are different in any morphological tense from the similar bars found in other Assistance of the control of the similar bars found in other Assistance of the control of the significant that their relations to the wall of the sac in these two groups, being attached throughout their length in Botryllus in place of only at the angles of the mesbes as in Ascada, and are therefore somewhat different in their development (ontogeny), there on scarcely be any in their development (ontogeny) there can scarcely be any the branchal size as are alike, and are therefore homologous

structures

(3) It follows from what has been said above in regard to the ongin of the Compound Ascidians, that even though the group Polystyelidæ is placed (as was the case in the Challenger Report) in the Ascidiæ Composita: it is not thereby widely separated from its relations amongst the Simple Ascidians. If the sub-order Ascidiæ Compositæ is retained, then the Polystyelidæ must go in it, since they form definite permanent colonies with the ascidiozooids embedded in a common test; but of course these forms are very similar in many respects to Styela and Polycarpa-that being one of the points of contact between Compound and Simple Ascidians—and therefore I tween Compound and Simple Ascignins—and interiors a can agree fully with all that Lacaze-Duthers and Delage say in favour of that relationship. The matter stands simply thus—If Ascidiæ Composite is retained, the Polystyelidæ must be placed in it at the nearest point to Polycarpa amongst Ascidiæ Simplices, while if Ascidiæ Compositæ is abolished, the Polystyelidæ will form a family or a sub-family (it matters little which) alongside the Styelinæ under Ascidiæ Simplices To go further, and break up even the genera of the Polystyelidæ, placing the species beside those Cynthiadæ they resemble most in the structure of the branchial sac, would be to give no value at all to the property of reproduction by gemmation and the formation of colonies.

and the formation of cointies.

(4) It has long been recognized that there are two groups of forms in the family Cynthiudar, those which centre around Sypiel and those related to Cynthia, and when the remarkable stalked forms, such as Boltenia and when the remarkable stalked forms, such as Boltenia the deep-sea genius Culedula, that been added, I defined these three groups as sub-families under the names Stytelinac, Cynthinae, and Bolteninae. Leaving the last

out of the question, we have the two former distinguished amongst other characters by the fact that the Styelinæ have never more than eight folds in the branchal sac, and have simple tentacles, while the Cynthinæ have always more than eight folds, and compound tentacles.

A few years ago these seemed well-established characters to which there were no exceptions. Last year, however, Lacaze-Duthers and Delage published a preliminary account of a Cymbia from the French coasts, with only eight folds (as in Stychine) in its branchial sac; while Trausted four folds on the right ado of the heranchial sac compound (as in Cymthina); and 1 find that long ago Alder described the reverse case in Cymthia. Holder of the compound (as in Cymthina); and 1 find that long ago Alder described the reverse case in Cymthia Nobrovia, Marg, where there are twelve folds in the branchial sac (Cymthia), although the tentacles are simple (Stychina). Stychina have been found, which is perfectly natural and satisfactory to the evolutionist, and the question for the systematist now is, Must these two subfamilies be united? I think not. I believe that they are natural groups, and that they are really as weldy separated more completely isolated from one another by the extraction of intermediate

forms

If these interesting links, to which attention has just been drawn, and which are apparently not common nor widely the better and the state of the state o

(5) The genus Botryllur's seems to contain an endless sense of forms which might be (and many of which have been) described as separate species. Clark, twenty years ago, pointed out the great variability of the species in this genus, and described many varieties and local conditions, but the supply is not yet eshausted, and one is almost tempted to conclude that no satisfactory position can be taken up anywhere between the two extremes of other (1) regarding the whole genus (or even the family Bortyllide); as an enormous protean species, or (2) de-

sections nearly every colony as a separate species.

From the point of view of the systematist or speciographer who wants "good" and well-defined species, this group of Ascedians must be an abomination, but to the student of evolution 11 is full of interest. Here, if anywhere, characters can be seen varying in all

³ Even this difference is not constant. In some Botryllidm, and I think in all Polystycelide and many Cynthidm, the relations of the bars in the adult are precisely as in Ascidia, Come, and Extensection.

These are the chief characters, but there are others, such as the condition of the stomach and digestive glands

directions and to almost all degrees, some variations becoming face while others remain indefinite. I am at present examining (with the help of my former student, Miss A. E. Warhan, B.Sc.) the anatomical characters of a number of colonies of various Bestylius with the view of inding which characters, if any, can be relied on in distinguishing species or "forms," and I are reasonable in which the branchial tentacles, usually regarded as important features in the diagnosis of species, present all variations between eight and sixteen. Every one of the numbers 8, 9, 10, 11, 12, 13, 14, 15, and 3 fo, in represented by one or more saciotosoids, although 8 and 16 are those most commonly found. Also several definite and in the same of t

Il have heard it said, and I fancy it may be often thought, that since evolution has changed our conception of a species, the modern biologist need not concern himself with the description and nomenclature and delimitation of those assemblages of variable forms which the control of the second se

Many of these more general remarks will no doubt apply to other groups of organisms with as much force as to the Tunicata, but some of the instances discussed above may seem points of mere detail of no great general interest. I believe, however, that they are typical cases illustrating difficulties which may confront any specialist continuous many confort are of the proposed object of biological investigations. Autrail or greater classification of animals and plants.

February. W. A. HERDMAN

PHOTO-STELLAR SPECTRA.

PROF. PICKERING, while retaining the four types of stellar spectra, finds that so many stars show an intermediate stage of development, that, in the Draper Catalogue, letters are substituted for the types. Thus, letters A to D denote stars of the first type; E to I, stars of the second type; M, stars of Type III, while N is reserved for fourth type stars. It weemed of some compared to the stars of the second type in the stars of the second type and second types, the observations of Vogel ("Spectra of the stars of the second types, the observations of Vogel ("Spectra of the stars of the second types, the observations of the star of the second types, the observations of the star of the second types, the observations and the star of the second types, the observations are started and tabulated, those being rejected where there was any uncertainty as to type in Vogel's observations. The following table shows the results thus obstanted.—

"Note on the Classification of Star Spectra in vol xxvii Harvani Avnals, and on some Stars with Bright Lines" NO. 1128, VOL. 44]

To show the differences in type, the following table has been drawn up ---

These tables show that, in the case of Type I, nearly half the stars observed with the eye are really Type II according to the photographs; in the case of Type II, four out of the forty, although having a clearly pronounced first type spectrum to the eye, are really second type stars according to the photographs. In the case of the second type, four stars out of forty-two are really first type.

For the third type stars, Dunér ("Sur les Étoiles," &c)
was consulted, and the following results were obtained.—

Dunés Eye observation Type	Pickerine Photographic observation Letter							
III.	V.	F	F	H 19 24	I 2 2	<u>K</u>	М 8 22	
111. !! 111 !!!	3	-	=	16	1	i	24 12	
The set 1				11				

This table may be condensed as follows:--

The photographs therefore show that only 36 per cent are third type at all. In order to account for this very remarkable result, the words of Prof Pickering may be added to the condition of the profit of the state of the state

It will be seen that three stars of the third type appear as first type stars on the photograph These are —

(1) LL 3717, 1h. 55m - 9°0'4, Dunér III " "Les bandes 2-9 sont fortement développées, très larges et sombres."

(2) D M. +17° 1479, 6h 56m. +17'53'8, Dunér III!!
"Tes bandes 2-8, et peut-être 9, sont visibles, elles sont très larges et fort obscures autant dans le vert-bleu que dans le rouge"

(3) "Serpentis, 15h 31m. + 15 25'9, Dunér III "
"Les bandes sont larges et fortes, surtout dans le vert et dans le bleu"

Prof. Pickering states, in the preface, that when the brightness exceeds 6's it is difficult to classify the spectrum with certainty. The photographic magnitudes of these stars are 6 65, 645, 64 et respectively.

As regards the fourth type, it is stated (p. 3) that "the

As regards the fourth type, it is stated (p 3) that "the letter N is reserved for spectra of the fourth type, although no star of this type is bright enough to appear in the Draper Catalogue, owing to the red colour of all such

sters " This seems to be a mistake, as three fourth type stars are found in the Draper Catalogue. They are :-

Name	RA	Decl	Pickering's	Photo	Dupér
D M. +17 1973	8 49+	+ 17 36	. H	6 65	IV. '!!
D M +68 617 D.M, +76 734	10 38	+ 67 56 + 76 22	A? E	6.20 7.08	IV. "

These stars each occur on one plate only.

The photographs show that the following stars have bright lines in their spectra -

Known variable stars . & Aurigæ, a Orionis, (Gemin-

orum, a Herculis, & Pegasi. Suspected variable stars · a Cassiopeiæ, 66 Ceti, p Persei, a Tauri, 8 Canis, 8 Geminorum, a Bootis, 8 Urse

Minoris, & Cygni, y Cephei. Other stars showing bright lines, not hitherto detected,

rer stars snowing origit innes, not intherto detected, are r-Ceti, γ Andromelæ, κ Persei, α Persei, γ Persei, 8ο Tauri, ζ Aurigæ, ζ Cancn, σ' Urse: Majoris, ο Leonis, γ Leonis, ξ Urse Majoris, γ Bootis, γ Scorpii, β Coronæ, ζ Herculis, γ Herculis, μ Herculis T. F. ESPIN

SOME ASPECTS OF STAS'S WORK.

FOR the last thirty years Stas's work has set the standard of excellence in all that relates to atomic weight determination. The literature of the subject teenis with references to his classic memoirs, which have come to be regarded by chemists in the light of canonical books Admiration of the almost magical accuracy of Stas's results seems somewhat to have diverted attention from the rare philosophical insight displayed in the plan of his researches Yet it is not too much to say that, while we owe the conception of the atomic theory to Dalton, Stas first placed the theory on a sound experimental basis.

It was in the year 1843 that Dumas and Stas's value for the atomic weight of carbon recalled attention to the favour on the Continent The subsequent work of Dumas and of de Marignac led these chemists to support the hypothesis in a modified form. In 1860 appeared the first series of Stas's researches, "Sur les Rapport reciproques des Poids atomiques" In the introduction to his paper the author stated his conviction that these researches furnished proof, as complete as the nature of the subject admitted, that the hypothesis of Prout was a pure delusion —that there was, in fact, no common divisor between the atomic weights of the elements. In reviewing the work of Stas, de Marignac admitted the impossibility of reconciling the concordant results obtained by Stas and himself with even the modified form of Prout's hypothesis he regarded the dictum quoted above as too absolute in character It was by no means established, he contended. that the constituents even of stable compounds are present evactly in the proportion of the atomic weights De Marignac's criticism struck at the very basis of the atomic theory but this by no means deprived it of its weight The laws of chemical combination are the experimental basis of the atomic theory, and Stas admitted that these laws had never been proved as "loss mathématiques. Writing in 1865, in the introduction to his "Nouvelles Recherches," he remarks that some of the fundamental ideas of chemistry, which are generally taken as having been proved, are as a matter of fact far from being so. He considers that the constancy of composition of chemical compounds has been experimentally established, but points out that this does not constitute a proof of the law of constant proportions, the law, viz., which states that the particular proportions in which two elements are combined in a certain compound is a constant proportion in all the compounds which contain those elements. This had

NO. 1128. VOL. 441

never been proved, yet it was only in this way that the position of the atomic weights as constants of nature could be established. The so-called law of multiple proportions Stas referred to as an hypothesis of Dalton, pointing out that the very rough analyses on which Dalton relied—of which the error is frequently more than to per cent —as well as the results obtained by Wollaston and by Gay-Lussac, were at most capable of establish-ing a "loi limité." The state of science at the time demanded a thorough re-examination of the basis of the atomic theory Stas realized this need, and took upon himself the burden of the task. The conception and plan of the "Nouvelles Recherches sur les Lois des Proportions Chimiques" show the mind of a great thinker not less clearly than the results of the work exhibit the skill of a master in the art of experiment.
The "Nouvelles Recherches" contains a verification as "loi mathématique" of the law of conservation of mass, in the complete synthesis of silver iodide, and the complete analysis of silver iodate. The constancy of composition of chemical compounds was subjected to a crucial test in the experiments on ammonium chloride, and the constant proportion between the combining weights of elements in different compounds was tested in the conversion of silver iodate, bromate, and chlorate, to the corresponding haloid salts The law of equivalent proportions was verified by the concordant results obtained for the atomic weights of silver and of the alkali metals determined as functions of those of rodine, of bromine, and of chloring respectively, oxygen forming the common stand-ard. One cannot help regretting that the law of multiple proportions was not also made the subject of investigation The most suitable examples occur among gaseous substances, and the operations of gas analysis were foreign to the methods of manipulation employed by Stas. complete analysis of nitrous oxide was indeed contemplated in order to determine directly the atomic weight of nitrogen as a function of that of oxygen, but the idea was abandoned owing to the difficulty of constructing the necessary apparatus.

The work on the laws of combination furnished fresh materials for the examination of Prout's hypothesis Stas's comments on the origin of this hypothesis possess a high degree of philosophic interest The remarks to which we more particularly refer are the following .—" Lorsqu'on remonte à l'origine de l'hypothèse (de Prout) on s'aperçoit immediatement qu'elle doit sa source à un préjugé ou, si l'on veut, à un opinion préconçue, concernant la simplicité des lois de la nature. Pendant longtemps les chimistes comme les physiciens, dès l'instant qu'ils ont vu certains faits se reproduire avec une apparence de régularité, ont ciu λ l'existence d'une loi naturelle susceptible d'être exprimée par une relation mathématique simple. . C'est à cette tendance, d'ailleurs très-naturelle, qu'on doit l'hypothèse de Prout." Dalton's enunciation of the law of multiple proportions is relegated by Stas to the same category as a generalization on insufficient data Mendeleeff has remarked (Faraday Lecture, 1889) that the periodic law has shown that the masses of the atoms increase per saltum, in a manner which "is clearly connected in some way with Dalton's law of multiple proportions." Dalton was more fortunate than Prout combining proportions are expressible by a simple mathematical law, whilst the atomic weights are only to be represented by a complicated formula which may have

some such form as that proposed by Carnelley
The "Nouvelles Recherches" appeared in 1865. first paper on the periodic system was read before the Russian Chemical Society in the spring of 1869. It is curious to reflect that the foundations of the atomic theory had hardly been made sure by Stas ere they were called upon to bear the magnificent structure raised by Mendel

NOTES.

We punt elsewhere the proceedings of the important deputstion to the Board of Trade on the subject of the Institute of Preventive Medicine. There can be no doubt that, after the statement and by the Minnter, the registration of the Society will shortly be an accomplished fact; a few words in the deed of registration or a few minute or freference between the Board of Trade and the Home Office are all that is needed to sufeguard Sir Michael Hicks-Beach's Official scrupter. The importance of the deputatives are the sufficient of the sufficient of the sufficient of the case of the Art Gallery, that men of accidence are no longer willing to be suitabled by men in officience are no longer

THE annual meeting for the election of Fellows was hold at the Royal Society's comes, in Burlington House, on Thursday last, when the following gentlemen were elected into the Society—William Andenson, Pof Frederick Orpes Rower; Sir John Conroy, Bart, 1 Prof Daniel John Cunningham; Dr. George Mercer Dawson, Edwin Bailey Elhot; Frof, Perry Frankay Frankland; Perry C. Gilchnat, Dr. William Dobanson Hallbatton, Oliver Heavatide, John Edward Marr; Ludowy Mond; William Napier Skaw; Prof Silvansa Philips Thompson, Captan Thomas Henry Tarad, R.N.

MR GEORGE HOLT, of Liverpool, last week sent the Treasurer of the University College there a cheepe for ten thousand pounds as endowment for a Char of Physiology, and candidates for the appointment are forthwith to be advertised for. It is only a few weeks since Mr. Brunner, M.P., sent a smular cheque to endow a Chair of Political Economy. The latter post has been offered to and accepted by Mr. E. C. K. Gonner

THE Prince of Wales has fixed 4 o'clock on Wednesday, June 17, for the delivery by Lord Rayleigh of the first of the two lectures at the Royal institution in connection with the centenary of the birth of Michael Faraday, and Friday evening, June 26, 419 o'clock, has been appointed for the second of these lectures, which will be given by Prof Dewar.

STUDENTS of geology were sorry to hear of the death of Dr P. M Duncan, F.R S He died on May 291n his satty-seventh year Dr Duncan was Professor of Geology at King's College, London, and was intimately connected with the Geological Society, of which he was President in 1876 and 1877 He was also a member of the Lunnean Society.

MR G. V Poore, the Government Inspector, who have recently drawn up a report upon experiments performed on luving animals during the year 1850, states that during the hear slyon, states that during the many vults he has paid to places licensed for the performance of such experiments, it has never failen to his lot to see a single animal which appeared to be in boddy pain

WE are glad to be able to announce that Mr [Graham-Kerr, of the University of Edinburgh, Naturalist to the Pilcomayo Expedition, has returned safely to this country, and has succeeded in bringing with him a portion of his natural history collections. As is well known, the Bolsvia, in which Captain Page and his expedition ascended the Pilcomayo, was stranded in that river, in April 1890, in the middle of the Gran Chaco After the death of Captain Page, which occurred while he was returning in a canoe down the Pilcomayo to get medical assistance, the Bolsvia remained stuck fast nearly in one spot until March of this year, when Mr. Kerr, finding the vessel still immovable, and no prospects whatever of a rise in the river, decided to come away as best he could After a very rough journey he reached Asuncion on mule-back, bringing as many of his light things as possible, and arrived in this country last week Some very interesting letters of Mr Kerr's, describing the natural history of the Gran Chaco, will be found in the two numbers of the Ibis for January and April last.

NO. 1128, VOL. 44

UNDER the will of Dr Fothergill (1821), funds were bequeathed to the Society of Arts for the offer of medals for subjects, in the first instance, relating to the prevention of fire A Society's Gold Medal, or \(\inf 20\), is now offered for the best invention having for its object the prevention or extinction of fires in thetries or other places of public amusement

MESSRS, NEWTON AND Co, have been appointed philosophical instrument makers to the Royal Institution of Great Britain, an appointment which we believe has not been held by any firm for some years

MR JOHN T BRUNNER, MP, has been elected President of the Sanday Society in succession to Prof. G. J. Romenes, Mr. Brunner will deliver his presidential address at the Society's public annual meeting on June 27

Till Societé Botanique de France recently held it, annual meeting in the little town of Colloure, near Perpignan, on the Mediterranean coast. After the meeting many excursions were made in the neighbourhood, which is interesting to botanists

On behalf of Prof F C Stirling, of the University of Adelaide, South Australia, Prof. Newton communicated to the Zoological Society of London, at its meeting last week, a figure of the new Australian Marsupial, originally described by Dr Stirling in this journal in 1888 (NATURE, vol xxxviii p. 588), together with some notes on this extraordinary animal. Notorycles typhleps, as Dr Stirling now proposes to call it, is a small molelike animal belonging to the order of Marsuptals, of which it forms an entirely new type A general description of it has already been given, as above referred to, but Prof. Stirling now adds that the Marsupial hones are exceedingly small nodules, and escaped his notice at first. Four or five of the cervical vertebræ are fused, and there is a keeled sternum, an enormously thick and short first rib, which serves a purpose of buttressing the sternum in lieu of coracoids, and a bird-like pelvis. The penis is in the uro-genital canal, and the testes are external in front of it. The eyes are mere spots underneath the skin. The four specimens as yet received of Notorycles typhlogs were obtained in the centre of Australia, on the telegraph line between Adelaide and Port Darwin The animal is said to burrow in the sand with great rapidity A full description of it, it is understood, has appeared in the Transactions of the Royal Society of South Australia, but no copy of this journal has as vet reached England

MM. Grehan'r and Quinquaud conclude from some recent experiments on dogs that under the influence of alcohol muscular strength is much diminished.

PROF JOHN M. COULTER, the well-known botanist, has been elected President of the State University of Indiana, located at Bloomington, and Dr. Douglas H. Campbell has been appointed Associate Professor of Botany at the new Stanford University of California

ACCORDING to the Botanucal Gazette, Mr. Thomas Mechan, of l'hiladelphas, is about to establish, in conjunction with his sons, a new journal of gardening and botanucal miscellany it will be called Mechan's Monthly, and the first number will appear on July.

We learn from the Journal of Eddary that Mr. Worthungton G Smith is preparing for the public gallery of the Bonanical Department of the British Museum a series of 66 tables illutrating the British Fungs. Every species of the Hymenomycetes will be figured in its natural colours, the drawings being taken from Mr. Smith's own series already in the Museum, with others from ongual figures tent by Mr. Flowraght and others.

THE number of Neptunia for April 30 gives a brief description of the following stations for the study of natural history ---

A marine mological station has been founded at Endoume, near Marsellies, by Frof. Marone, specially for the study of the fabre of the Mediterranean. M. Alphonne Bioson is about to establish at his own expense a coological station at Fount-de-Grave, Gironde, with the especial object of promoting the investigation of the omithology and eniomology of the district A marine station for physiology has been opened at Tamania, Physiology in the Facility of Stepces at Lorina.

The Berlin Academy of Sciences has recently made the following grants:—£(100 to Dr Fleischmann, of Erlangen, for researches in development; £30 owards the cost of publication of Dr. Krabbe's work, "Development-Huttory and Morphology of the polymorphous Lichen Genus Cidadoma", £60 to Dr. Hartwig, of Bamberg Observatory, towards a sense of observation on variation of the earth's ass, and £60 to Dr. Schmidt, of Halle, for researches on the light reflected from transparent bodies.

THE following are subjects for prize competition, recently proposed by the Belgian Academy of Sciences .- Advancement of our knowledge of the relation of phenomena of solution to phenomena of combinations, discussion, on the basis of new experiments, of works relating to the kinetic theory of gases, perfection of the theory of approximative integration, both as regards rigour of methods and facility of application, researches on the embryonal development of a mammal belonging to an order the embryogeny of which has not yet been investigated . determination, by means of palgeontology and stratigraphy, of the relations between formations referred by Dumont to his Lackenian and Tongrian marine systems, new researches on the formation of polar bodies of animals The prizes are gold medals, of the value of 1000, 800, and 600 francs Papers to be written in French, Flemish, or Latin, and sent to the Secretary before August 1, 1892

MRSSAS RICHARD FARRES have issued an illustrated catalogue of measuring, controlling, and self-registering instruments for scientific and industrial purposes. A descriptive and illustrated list of instruments has also been published by the Cambridge Sensitis Instrument Company.

THE series of lectures annually given in the gardens of the Royal Botanic Society of London upon subjects connected with botany came to an end on Friday last, when Prof. Stewart, F.R.S., President of the Linnean Society, addressed a large number of visitors and students upon "The Relationship between Plants and Animals." The subject, he said, was one of much interest, as affording an explanation of the origin of many abnormal forms of vegetable growth. This is specially the case in tropical countries, where the struggle for existence is more intense than in colder climes , there the relationship is almost vital, some plants providing food, others shelter, to various kinds of ants, while these pugnacious insects, in turn, protect the plant from damage, by attacking any living thing which approaches it. One plant, known as the bull's-horn acacia, of Central America, provides a species of ant not only with food and drink, in the shape of tiny egg-like bodies upon the leaves-of which the ants are very fond-and a sweet fluid in special cavities on the stalk, but, su addition, furnishes a home in the hollow somes with which it is armed, these, when punctured by the ants, swelling out into perfect miniature bull's horns. In return the ants protect it from its enemies.

A SERIES of experiments with regard to evaporation from free water surfaces and from earth saturated with water, in sun and an shade, has been recently made by Signor Battelli (IT Numos Cusents) He used three large tube or vats, two holding water, and the third earth on a grating, to which water was admini-

from a pipe entering the bottom. One water-tub and the earthtub stood a few yards apart on the north side of a high wall : the other water tub was in the open, and embedded in the ground. Signor Battelli's results are these .- The quantity of water evaporated from moust earth is in general greater than that from a free stagnant water surface, when the air temperature rises ; but less, when the latter falls. With increasing wind-velocity, evaporation increases more rapidly from the water surface. The moister the air, the greater (other things equal) seems to be the ratio of the water evaporated from the moist earth to that from the stagnant water surface. The evaporation of a water surface exposed to the sun's rays is greater than that of a shaded one. not only by day, but in the following night With rising temperature, the ratio between the water quantities from these two surfaces increases somewhat more quickly, with rising windvelocity, this ratio diminishes

THE. Photographic Journal of May 22 prints a paper by M. Lon Vidal, on photographic methods of obtaining polychromatic impressions. One of the writer's objects is to show that typographic and lithographic printers ought to find in photography "one of their principal satisfaces." By its ad, he says, their work might be executed "more cheaply, more thoroughly, and more artistically."

On Sunday, June 7, there was a series of severe earthquake shocks in Italy. The centre of the seismic movement seems to have been in the province of Verona, but the disturbance was felt over a wide area. At Verona three strong shocks, preceded by a subterranean noise like the roaring of artillery, are reported to have occurred at 2 o'clock a m The inhabitants rushed in terror from their houses to seek safety in the open streets and squares One of the assistant mistresses at a boarding-school died of fright A number of chimneys were thrown down by the oscillation Still more violent were the effects of the seismic disturbance at other places in the province of Verona, especially at Tregnago and Badia-Calavena Shocks more or less severe were experienced at Brescis, Belluno, Ravenna, Parma, Modens, and Ferrara. The Central Meteorological Bureau reports that the earthquake was very strongly felt at l'Iorence, where it awoke several people from their sleep. The disturbance also extended to Rome, as was shown by the seismograph, the time nt which the shock was felt in Rome being 6 minutes and 40 seconds after 2 a m. In Verons and the surrounding districts slight shocks continued to be felt on Monday and Tuesday. A large stream of lava issued on Monday from the new crater of Mount Vesuvius at the base of the central cone. Signor Palmieri, the Director of the Vesuvian Observatory, holds that this flow is directly connected with the earthquake shocks in the north, and points out that seismic disturbances in Italy generally stop when the eruption of Vesuvius begins.

In the Report of the Meteorological Service of the Dominion of Canada for the year ending December 31, 1887, just issued, it is stated that nearly eleven hundred warnings of approaching storms were issued by the Service during the year, and that of these warnings 972 were verified, being 8879 per cent.

We have the pleasure of recording the issue of the first wolume of the Poblications of the Vancan Observatory, containing astronomical and meteorological observations for the last nine months of 1890. This Observatory was first established by Pope Gregory XIII for astronomical purposes, and was need for regular meteorological observations from 1800-1821. After passing through several vicinitudes, a proposal was made, about the time of the Valucial publice Exhibition in 1888, to recorganize the Observatory, and the present Pope accordingly the resultablesh or no a sound basis, and it is now furnished with the best instruments procurable, both for direct observators and continuous registration in meteorology, astronomy, mag

netum, and earthquake phenomena. It is proposed to carry on varous researches, and to issue further volumes from time to tume, as soon as sufficient materials are accumulated The Director is Padre Denza, the founder of the Italian Meteorological Society, and Superintendent of the Observatory at Moncalatri.

CONSIDERING the question of determination of the evaporating power of a climate, Dr. Ule distinguishes (Met Zests.) between the intensity and the speed of evaporation The latter can be well determined with an instrument like Wild's evaporimeter. and Dr Ule sets forth, in a table, the monthly data of this for Chempitz, compared with those of absolute humidity. "saturation deficit," and relative humidity. The agreement of the last with the evaporimeter figures is much better than that of the two others : still, there is considerable discrepance, and this is not explained (the author shows) by variations in windintensity. On the other hand, the data of the psychrometer show a remarkable parallelism with those of the evaporimeter, and by taking wind-variations into account the agreement is sucreased. Thus, from psychrometer differences and wind variations, the evaporative power of a climate may be correctly estimated where an evaporimeter is wanting. Dr. Ule offers a new formula for estimating the layer of water evaporated in a given time, and tests it with two German climates, and one Australian

In an interesting paper on technoal education in agriculture, respirated from the Journal of the Koyal Agricultural Society, Dr. W. Fream refers incidentally to the value of mathematical studies for the agricultural. Dr. Fream's professional expensions at agricultural colleges has convinced him that a lad who is a starty completant in mathematical usides is "a good medium to work upon," "Those interested in the welfare of any young agricultural, stool did take care," he say, "that in his school days the study of mathematics is not ignored. The time devoted to acquiring professioner, in arithmetic, geometry, emissiration, and the elements of algebra and trigonometry—the latter really indispensable in the case of surveying—will never be regretted."

THOSE who are interested in questions relating to physical education will find much to please them in an excellent paper. in the lune number of Physique, on natural history in public schools, by the Rev T. A Preston, late President of the Marlborough College Natural History Society. Many boys are not much attracted by games, and it seems hard that in such cases any sort of compulsion should be used. Why not have various alternative ways of securing exercise, any one of which might be chosen? Mr. Preston shows with great force, and in a very interesting manner, with how much advantage the study of natural history might in some instances be substituted for cricket and football. Boys out for a field excursion take a great deal more exercise, he maintains, than is ever taken at cricket. "With those who are keen naturalists," he says, "the mere exercise taken in any one day (not in an excursion) is often such that it might almost be said to require moderating I have no hesitation in saying that, if exercise alone is to be considered, a field naturalist will take far more than any one at games.'

ME. W. R. HILLIER, of the Indianc Unil Service, has written a very circius monograph on the manners and outsons of the Shan States. When a Shan becomes a father it is considered highly undersinght buth the should drive pige, carry the dead, tower holes, fill in holes in the ground, or indiage is monetime to the body. Hore buth, in Hillier, "the without marrying, the body, here buth, in Hillier, "the without marrying, the body, here buth, in Hillier, "the without marrying the body, here buth, in Hillier, "the without marrying the body, here buth, in Hillier, "the without marrying that body, here is the body, here are the body here considered as representing the husband or wisit."

unrequited affection in the next stage of existence is simplicity itself. A young man takes a fancy to a young lady, and if the liking is reciprocated, she straightway accompanies him to his house as his wife. Next day the young man's parents meet the parents of the young lady, and after informing them of what has taken place, beg that "they may be forgiven for the intrusion," and ask that a day be fixed for the wedding This request being granted-and apparently a refusal is not contemplated-the young lady returns to her parents. Divorce is easy also, the man merely giving his wife a letter permitting her to remarry, and the wife merely being required to pay an unwilling husband thirty rupees for release from an uncongenial mate As to food the Shan is not an epicure, eating everything that is eatable; and indeed it is considered quite becoming, if he only be of high rank, to devour an enemy This privilege, however, is accorded only to Bohs, or chiefs The Shan theory of the cosmorony is that "the earth came out of the depths by means of white ants."

Some further explorations have lately been made on the Upper Irrawaddy Major Hobday, of the Indian Survey Department, with an escort of fifty Goorkhas, succeeded in getting as far north as latitude 26° 15' up the Malika, or right branch of the river. Here the local tribes began to show opposition, and the party could not without fighting their way have proceeded further The point reached was, however, only fifty miles south of that which Colonel Woodthorpe gained a few years ago in his ex-plorations from the far north of Assam This small gap will prohably be crossed when the next attempt is made, as by that time the wild tribes will have learned from their neighbours that British officers have only friendly intentions towards them Finding his progress barred to the north, Major Hobday turned due eastwards, with the intention of striking the Meka, which is supposed to be the main stream of the Irrawaddy. After exploring the course of this river for some distance, he will journey back through the hills along the Yunnan border, reaching Bhamo by land. He will thus be able to map a considerable extent of country.

An interesting synthesis of troilite, the crystallized monosulphide of iron. FeS, which is so frequently found in meteorites and yet is never found in terrestrial rocks, is described by Dr Richard Lorenz, of Gottingen, in the current number of the Berichte, A stream of dry sulphuretted hydrogen gas was led over a bundle of iron wire contained in a combustion tube heated in a furnace As soon as the wire became heated to dull redness, it became quite changed, becoming completely covered with innumerable brilliant little crystals. These crystals possessed a bright silver white lustre when first obtained, but after a short time reflected a pale-green coloured light. On standing for some days, the crystals further changed in colour to blue and afterwards to brown, without the least change in the form being apparent. Under the microscope they appear to consist of wellformed six-sided tables of a bright steel-gray lustre. Prof. Groth, the eminent crystallographer, who has examined them, pronounces them to be hemimorphic hexagonal in form, isomorphous with wurtzite, the hexagonal variety of zinc sulphide, Any kind of iron may be substituted for the wire; whatever the variety employed, it always becomes covered with a crust of these crystals when heated in a stream of sulphuretted hydrogen, the only precaution necessary being to prevent the temperature from rising to the melting-point of monosulphide of iron. The crystals are readily detached from the iron, and upon analysis yield numbers very near the theoretical ones required by Feb The largest and best developed individual crystals of troilite are obtained by diluting the sulphuretted hydrogen with an inert gas. Wurtzue, sulphide of zinc, ZnS, may also be readily artificially obtained in a similar manner by passing sulphuretted

hydrogen over zinc heated to whiteness in a porcelain tube in a Schlosing furnace. When the tube, which is allowed to cool in the stream of gas, is broken, immediately beyond the portion which has been heated in the furnace a beautiful sublimate of crystals of wurtzue is found. They consist of well developed hexagonal prisms, somewhat transparent and of a yellow colour. exhibiting, according to Prof. Groth, their hemimorphic nature in a most decided manner. In a similar way also Dr. Lorenz has artificially prepared greenockite, aniphide of cadmium, CdS. This synthesis is perhaps the easiest of all to effect, and it may readily be conducted in an ordinary combustion-tube. The metallic cadmium is placed in a porcelain boat, and commences to react with the sulphuretted hydrogen at a temperature just below its boiling-point. As soon as this temperature is attained, the porcelain boat and the portion of the tube beyond it become covered with magnificent long yellow skewer-like crystals of greenockite, which Prof Groth finds to be of two kinds, hexagonal prisms isomorphous with troilite and wurtzite. and a new form of greenockite consisting of monoclinic crystals Dr. Lorenz has further artificially prepared millerite, the sulphide of nickel, NiS, by the same method, obtaining in this case very minute but undoubtedly hexagonal crystals isomorphous with the three other sulphides above deserrbed.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (Macacus cynomolgus ?) from India, presented by Mr. Walter Fraser, a Rhesus Monkey (Maracus rhesus 9) from India, presented by Colonel Beresford . a Great Black-headed Gull (Larus schthyactus) from the Persian Gulf, four Macqueen's Bustards (Houbara macqueens & & 9 9) from Western Asia, three Chaplin Crows (Corvus capellanus) from Persla, presented by Mr B. T. Ffinch, C M Z.S.; a Diamond Snake (Morelia spilotes) from New South Wale-, presented by Mr. J Hellberg; a Common Viper (Vipera herus) from Hampshire, presented by Mr W. H. B Pain; two Piapecs (Ptilostomus senegalensis) from West Africa, purchased . a Colleged Fruit Bat (Cononycters; collasss), four North African Jackals (Canss anthus), two Partridge Bronze-wing Pigeons (Geophaps scripta), bred in the Gardens

OUR ASTRONOMICAL COLUMN

THE SPECTAR OF DOUBLE STARS —A note on "The Discovery of Double Stars by means of their Species", No. 5034 by Fed S. C. Federant to Astronomote Padarthetin, No. 5034 by Fed S. C. Federant to Astronomote Padarthetin, No. 5034 species, relative orbital motion in the line of sight may cause a specific doubling of the lines. Bin if the species he not similar any lines common to both ought to be conspiciously strong, and, provided the components have not equal and opposite velocities in the line of sight, ought also to be displaced with reference to other lines. Thus, if one component of a close binary system other lines. I hus, il one component of a close binary system has a Group V spectrum, like our sun, and the other a Group IV. spectru u, in which strongly marked hydrogen lines is the main feature, the resulting spectrum will have a composite character, and careful measurements should show that the position of the hydrogen line is periodically displaced when compared with the lines characteristic of the solar type spectrum a Canis with the lines characteristic of the solar type spectrum. Am Mayoris is the brightest star having this composities spectrums, and the wave-length of the hydrogen line. G. derived from a comparison with sights lines of greater and three lines of annalier and the second of the second appear cannot me pretentences as one to the results absorbed as a composed one quaranties of the composed of the second, as compared with the bright component. An examination when their the following stars have the composite spectrum effected to , 7 shoulmoneds, 11, 65 op., 160 or., a storying and the following disruption of District of the composite spectrum of the following disruption of District of the Composite Secondary of the Composite Seconda

distinctly separated from those of the chief stars. Although the distinctly separated from those of the chief stars. Although the strong hydrogen lines in the spectra investigated may be due to the presence of a faint companion, their intensity may also be due to many other causes. That, the strong hydrogen lines in the solar spectrum are not due to the integration of the spectrum of the sun and that of a companion. It is necessary, therefore, to determine whether the displacement is subject to a periodic variation or no, in order to test this method of discovering dose binaries

THE PERSEID RADIANT.—At the St. Petersburg Academy of Sciences, on April 22, M Bredichin concluded, from the meteor observations made at Pulkova by ten astronomers in August 1890, "le courant des acrolithes n'est pas délimité par un point ou un petit rond, mais présente une surface considérable parsemée de radiants."

THE FLORA OF DIAMOND ISLAND.

DIAMOND ISLAND is situated at the mouth of the Bass JIAMUND ISLAND is situated at the mouth of the Basseth River, in the Indian Ocean, about five miles from Pagoda Point and eight miles from Cape Negrasi, and in about 16. NI lail. It is of vanistione formation, somewhat exceeds a square inlie in area, being about twice as long as broad, and the central part is a kind of plateau 60 feet or so above the level of the sea. With the exception of a small clearing for a telegraph station, the shad as densely wooded down to the sea, but there swatten, the residual agencies woodca down to the see, but there is no inangrove belt on any part of the sandy coast, unless it be considered as represented by a few patches of Avicenna of plantatis. Thus is the siland described, though in greater detail, by Dr D Frain, Curator of the Herbartum of the Royal Bolanic Garden, Calcutta, who has visited the island in H M. Botanic Carcen, Carcutta, who has visited the issand in It at.

Indian Marine Survey steamer Investigator, commanded by R.

If Ioskyn, R N. Dr Prsin has published an elaborate analytical account of the flora in the Journal of the Asiatic Society of Bengal. He collected eighty-six species of flowering plants, three ferns, and four funguses, among which there was not a single novelty. The enumeration includes a number of cultivated plants, among them the coco nut paim; but these are all of recent introduction. It is supposed that the island was not previously inhabited, and therefore that the vegetation of the dense wood overspreading the island is quite natural. The most in-teresting fact brought out is the evident affinity with the somewhat distant Andaman flora, pointing to a former connection.
The Report is also valuable to the student of plant-distribution for the details it contains of the habitats and relative frequency of the component species of the vegetation

W. BOTTING HEMSLEY.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE,-Lord Walsingham, F R S., the High Steward elect, has issued a letter of thanks to the Senate, in which he promises to maintain the highest traditions of "our belowed University

M Hicks, F R S, late Fellow of St. John's College, and Principal of Firth College, Sheffield, has been approved for the degree of Doctor in Science. Dr. Hicks is the author of many important memours in mathematical physics, and of an approved

text-book of dynamics
Prof Newton has been appointed a Manager of the Balfour From Newton has been appointed a Manager of the Bailour Studentship Fund for five years.

A. H. L. Newstead, Scholar of Christ's, and E. W. Mac-Bride, Scholar of St. John's, and President of the Union Society, have been nonunated for research work at the Naples Zoological.

Station The Syndicate appointed for the purpose have selected a site for the Sedgwick Memonal Museum on the old Botanic Garden area, with a frontage to Dowaing Street. The proposed Museum will lie between the new Chemical Laboratory and the old Anatomical School, and complete one quadrangle of the new

Elias Metschurkoff, Director of the Parls Pasteur Institute, Prof. W. H. Flower, C B., F.R.S., and Mr. W. E. H. Lecky.
Delegates from the seventh International Congress of Hygiene

Delegates from the seventh international Congress of frygene and Demography will be received by the Vice-Chancellor in the Senate House on Saturday, August 15.

The Museums Association hold their annual meeting in July in the buildings lately erected for the departments of Anatomy.

and Physiology.

Prof. Foster is appointed by the University a Member of Council of the Marine Biological Association.

The reference to the Syndicate on the question of Greek in the Previous Examination has been enlarged to include Latin also, and will be decided on by the Senate early in the October

term. An animated discussion on the question took place in the Arts School, in which the claims of modern (non-classical) education for consideration by the University were strongly put forward by men of the highest classical distinction

Mr. J. N Keynes, the Secretary for the Local Examinations,
has been approved for the degree of Doctor in Science.

An election to an Isaac Newton Studentship will take place in

October. The value is £200 a year for three years from April 15, 1891. Candidates are to send their names and testimonials to the Vice-Chancellor between October 1 and 10.

It is proposed to affiliate the University to the University of Adelaide, South Australia

Adelator, South Australia
The General Board of Studies propose that Dr Ruhemann,
hitherto Assistant to Prof. Dewar, shall be appointed a Univer-

hitherto Assistant to Prof. Dewar, shall be appointed a Univer-sity Lecturer in Organic Chemistry.

A room in the new Physiological Laboratory at to be set aside for Psychophysics, and a grant of Z50 for instruments is recommended by the Ceneral Board.

The Annual Report of the University Observatory contains a

good record of work done and in progress Prof Adams is to be congratulated on the satisfactory way in which, notwith-standing his long and severe illness, the Observatory has been conducted

SOCIETIES AND ACADEMIES. LONDON.

Royal Society, May 14,—"On the Theory of Electro-dynamics" By I Larmor, Fellow of St John's College, Cambridge Communicated by Prof J J Thomson, F R S. The electrical ideas of Clerk Maxwell, which were cultivated partly in relaxion to mechanical models of electrodynamic action, led him to the general principle that electrical currents always flow round complete circults

When this principle of circuital currents is postulated, the theory of electrodynamics is reduced to the Ampère-Neumann theory of complete circuits, of which the trath has been fully established. It leads, as shown by Maxwell, to the propagation of electrical action in dielectric ments by waves of transverse electric displacement, which have the intimate relations to waves

electric displacement, which have the intimate relations to wares of light that are now well known.

The problem of determining how far these remarkable conclusions will still hold good when a more general view of the nature of dielectric polarization is assumed was considered by von Helmholtz in a series of memoirs

The most general conception of the polarization of a medium which has been formed is the Poisson theory of magnetization. The magnetized element, whether actually produced by the orientation of polar molecules, or otherwise, may be mathematically considered to be formed by the displacement of a matically considered to be formed by the displacement of a quantity olicida imagenic matter from an angiture to its posi-tive pole, thereby producing defect at the one end, and excess tive pole, thereby producing defect at the one end, and excess moment, which is the product of the shipping displaced by its moment, which is the product of the shipping displacement per distance through which it is displaced. The displacement per unit volume, neasured by the product, re equal to the magnetic moment per unit volume, whether the magnetized molecules full with momentum launch between the mysterior of discrete particles with momentum launch between them systems of discrete particles with unoccupied space between them

In the electric analogue we replace ideal magnetic matter by ideal electric matter; the displacement thus measured constitutes the electric displacement, and its rate of change per unit tutes une electric despitements, and its rate of change per unit time represents the dispitacement current in the dielectric. We have to consider whether a deplacement current of this type suf-fices to make all electric currents ericuital; and it will be suffi-clent and convenient to examine the case of a condenser which

is charged through a wire connecting its two plates. In the first place, this notion of electric displacement leads to the sam distribution of potential between the plates as the ordinary one, adopted by Maxwell, for in the theory of induced magnetism netic induction of Maxwell, of which the components are $-\mu(d V/dx)$, $-\mu(d V/dy)$, $-\mu(d V/dz)$, and which, therefore, eads to the characteristic equation of the potential

$$\frac{d}{dx}\left(\mu\frac{dV}{dx}\right) + \frac{d}{dy}\left(\mu\frac{dV}{dy}\right) + \frac{d}{dz}\left(\mu\frac{dV}{dz}\right) = 0,$$

corresponding to the one given above. If the displacement in the dielectric is $-\kappa(dV/dx)$, $-\kappa(dV/dx)$, $-\kappa(dV/dx)$, then

$$u = 1 + 4\pi\kappa$$

The displacement in a unit cube may, of course, be considered as a displacement across the opposite faces of the cube.

Now, considering the case of a plane condenser, let F be the Now, considering the case of a plane concenses, let x be the electric force in the dielectric between the plates, then the displacement is xF. Let o be the surface density of the charge conducted to a plate, then the effective electrification along that plate will be of surface density $\sigma' = \sigma - \kappa F$, therefore, by Coulomb's principle.

so that
$$\begin{aligned} \mathbf{F} &= 4\pi\sigma' \\ &= 4\pi(\sigma - \kappa \mathbf{F}) , \\ \sigma &= \frac{\mu}{4\pi} \mathbf{F} = \kappa \mathbf{F} + \frac{1}{4\pi} \mathbf{F} \end{aligned}$$

Thus the current is not circuital, but there is an excess of the surface density conducted to the surface over the displacement current from the surface, which is equal to F/4*.

The specific inductive capacity, as determined by static experiments on capacity, is here measured by μ , the coefficient in the expression for σ

In addition to this discontinuity at the face of a condenser pinte, the induction in the mass of the dielectric will not be circuital unless the electric force is itself circuital, which it is not in the general form of the electrodynamic theory. The most general type of electrodynamic relations which is consistent with the established theory of complete circuits, is discussed on the basis of you licimholta's work, but with

avoidance of certain restricting conditions introduced by him, the chief conclusion being a follows in a complete circuit the one thing essential to the established theory is that the electric force integrated round the circuit should be equal to the time rate of change of the inagnetic induction through it, and, therefore, have an ascertainable value, though

its distribution round the circuit is a subject of hypothesis. conclusion that waves of tran-verse di-placement will be propagated in a dielectric with velocity $kt^{-\frac{1}{2}}$ will hold good if we assume any form whatever for the electric force which does not violate this one relation, and also assume an electrostatic violate this one relation, and also assume an electrostatic polarization of the medium, equal at each point to the electric force multiplied by a contant K₁/4w.

The increased generality which can be imparted to the theory

merely leads to various modes of propagation of a condensational wave

If K2 denote the specific inductive capacity of the medium, measured in static units, this polarization constant K_1 is equal to $K_2 = 1$, and the velocity of the transverse waves is the ratio of the electric units of quantity in a medium of unit inductwo capacity multiplied by the static value of K_1^{-4} . The correspondence of the refractive index for the simpler media with K_2^{-3} , as well as direct measures of the relative velocities of electric waves in other media, give for the value of this velocity the same ratio multiplied by $K_s^{-\frac{1}{2}}$ These values can be reconciled only by the liming form of the theory of polarization which is equivalent to Maxwell's theory.

May 28.—"On the Anatomy and Physiology of Prolopterus annecteus." By W N Parker, Ph.D., P.Z.S., Prolessor of Biology in University College, Cardiff. Communicated by

Biology in University College, Caruin.

W. H. Flower, F. R.S.
The work which harmonic of 1888, when the author was form Freiburg in the winter the second of 1889, when the author was form Freiburg in the second of 1889, when the author was form of 1899, when the generosity of 170f. Wiredenbeim, As so tunate enough, owing to the generosity of Prof. Wiedersheim, to obtain a number of fresh spectmens for examination. As so many interesting points presented themselves at an early stage

in the research, a short preliminary notice, without illustrations, was published in the following autumn (Genchte & Naturpfersch. Gestlickseft as Werblung s. Br., vol. v. 1838; see also NATUR, vol. xuck. p. 19) This notice merely forms the basis of the present paper, in which the whole subject has been worked out in greater detail. A number of new facts are recorded, some of the author's earlier conclusions modified, and the paper illustrations of the subject with the paper illustration of the subject with t

the author's earlier conclusions modified, and the paper Illus-trated with 11 plates containing 7 figures.

With the exception of certain special details, the structure of the skeleton and of the nerrous and muscular systems are not described, the paper constitute mainly of an account of other cognas which have not received to much attention from previous observers, and of a comparison of Protograms with the other genera of Dippots, of are at their structure is known, as well as

with other Ichthyopsida.

A number of details with regard to the habits of Protopterus

A number of details with regars to use names or required in appropriate property of the connection with the characteristic property of the considerable nerve supply, are deviatedly greatly degenerated tractures as regards then free portions. Sensory organs are not present on them, and they berefore cannot have a sucie fine-flow. There deal ends, like the property of the control not primarily diphyereral, and shows signs of a possible origin from a heterocercal form.

The epidermis on the whole most nearly resembles that of

The epidermis on the wnote most nearly resummers was a premnibranchate Amphibans, and gives rise to simple multi-cellular glands, as well as to very numerous closely-packed goblet-cells, which produce the gluey secretion as well as the main substance of the capsule which surrounds the animal during the torpid state.

the torped state.

The integramentary sense-organs are nimitar to those of fisher The integramentary sense-organs are nimitar to those of fisher and the trush are similar to those seen in young stages of Fisher and in Amphiban larves, while in the case of the head they resemble those which are typical for adult Fishers End-bads, similar in structure to the taste-buds of Fishers and Amphibans, are present on the tongue and oral epithelium.

on the tongue and oral epithelium.

As regards its general structure, the olfactory organ most
nearly resembles that of Elasmobranchs, but the presence of
posterior notative masses it to a higher level. The posture of the
posterior notative masses it to a higher level. The posture of the
for as an adaptation in connection with the torput state. Four
straight and two oblique muscles are present. The selectric is
fibrous in young animals, and islands of cartiage first appear at
the points of unestron of eye-muscles, and then gradually extend
so na to chondrify the whole. The eye resembles that of Amphilbians; a Procursa fairfyrams and campionals delifers are

phibans; a presense false/prems and companula Hallers as absent, and no citary muscles were observed, though possibly present, almost all the pigment of the eye is excludented. The present in connection with the Ton Presented plants are present in connection with the Ton Presented plants are present in connection with the District Connection of the Con

to the cuticula actsis. In thyroid and thymas are usercined. A ventral, as well as a fenestrated dorsel, meantery to pretent supporting the intestine. The author compares the to-called uninary bladder ("clocacl acceum") with the "processue digitiformis" of Elasmobranchs. A spleen and pancreas are preent, embedded in the thin walls of the stomach, and extending on to the proximal part of the intestine; they are covered externally by sparse muscular fibres as well as by the peritoneum. The relasparse muscums notes as well as by the peritoneum. The relations of the pancreas therefore most nearly resemble those met with in Ganoids and certain Teleosteans. The pancreas is deeply pignemented, and its ducts open into the bile-duct. The pignented walks of the Intestine and the spiral valve are very thick, owing to the abundance of lymphoid dissecontained. bick, owing to the abundance of lymphoot tissue contained within them. With the exception of the birst entirest, the first within them. With the exception of the birst entirest, the first pagmented oblique folds, the whole of the success membrane of the stomach and mentine is prefictly smooth, and there is no indication of any differentiated gastric or intestinal glands. In the state of and untestine. A layer of small-celled hymphotic large directly underlies the epithelium. In the spleen and lymphond organs of the glatestine to knade of tissue as present. Large migratory

NO. 1128, VOL. 447

cells are present in both kinds of tissue, many of which inclose yellowish granules. Gradiations between these and rounded cells of a deeper yellow or bewore colour can appearingly be made and the ordinary black, branched pignetic cells can also be sean. It seems probable that the yellow granules mentioned above are due to the dusintegration of red corputeles, which are ingested by lescocytes, and then undergo some change, whereby the latter gradualty pass into the condition of black pignent cells, which are ingritted through the epithelman, and are so go crist of lot. The

muscular layers are very thin.

The question as to the mode of digestion and absorption of the

The question as to the mode of digestion and abtorption of the food in Protephs us is discussed.

The branchial apparatus shows signs of considerable reduction. The pulmonary apparatus, on the whole, more nearly resembles the air-bladder and its duct of certain Ganoids that the lungs and laryingo tracheal chamber of Amphibians. The pulmonary branches of the vague cross one another at the base

pulmonary oranness on use vapor of the large size of its elements, which is only exceeded in the case of *Protess* and *Aren*, as well as for the large proportion of white corpuctes in comparison with the red once. Two forms of the former are described. The chief points of interest with regard to the blood vessels when the protection of the content and the case seters, the left supplying the are. (1) the paired pulmonary artery, the left supplying the ventral, and the right the dorsal, aspect of the lungs, (2) the single post caval and persistent left posterior cardinal vein; and (3) the single caudal vein, giving rise to n right and a left renal portal.

No external sexual differences could be observed, and amongst

portal.

The victorial rexual inference could be observed, and amongst the specimens examined. Semiles were the more abundant. The urno gential organs are surrounded by masses of tissue-resimbling the large celled lymphoud tissue of the gut, but differing from the latter in becoming largely converted into an examined to the latter in becoming largely converted into and their duck the Wolffain duck, rephrotismens are abund.

In unspe males, delicate Mulleran ducts are present. The perma so conducted to the externor by a duct, which as probably formed in connection with the testis, quite mdependently of the with the state of the service of the Mulleran duct, the rest of which apparently about completely. Unlike most of the tissue elements, which are very large, and closely resemble are remarkable in possessing, rive whreat the figure is attached to the carrot-shaped "head". The generative organs of the femilerance oversetting is approached by the described amongst Urodeles. An account of the mode of his of Proteference atmitted to those which have recently been described amongst Urodeles. An account of the mode of his of Proteference aming the topic period in given. The coccount is provided with a "hid; the large of the animal, and thus forms a passage for the respiratory current. The source of nutriment during the supplement of the goal of the plant of the respiratory current. The source of nutriment during the supplement of the post of the connection with the goal of the plant of the speciment of the plant of the connection with the goal of the plant of the respiratory current. The source of nutriment during the supplement of the plant of the connection of the tesperatory current.

sleep lies in the adipose tissue in connection with the gonads and kidneys and alongside the notochord in the tail, as well as and kinneys and alongside the notochord in the tail, as well as in the lateral muscles, some of which, especially in the caudal region; the properties of the caudal region is the properties of the fairy degeneration, and, in all probability, lessocycles are the active transporting agents of the degenerated material. This assumption would help to explain the large development of lymphoid tissue in the body of the anımal

The systematic position of the Dipnos is briefly discussed in the logis of the new facts brought forward in the present paper, at though the Dipnos is possible places and in the light of the new facts brought forward in the present paper, at though the Dipnos present image points of resemblance to other, their connection with any living forms of either class is probably a very dustant one, and it is landwiselds to classify the probably and the property of the probably and places of the property of the probably and places of the places of the probably and places of the places of

Elasmobranchs, more particularly to the Chimseroids on the one hand, and to such as accent Selandhan type as Chianyleaclast, on the other; but, at the same time, the Canodis probabily arone creating many primitive characters, the Dapon, and more especially Perioderus and Legislariem, are in some respects highly specialized, the specialization being largely due to a charge of about.

"Method of Indexing Finger Marks." By Francis Galton.

F.R.S. F. K.S.
Sufficient proof was adduced by me in a memoir read November 27, 1890, before the Royal Society (Phil. Trans., B, 1891), of the extraordinary persistence of the papillary ridges on the inner surface of the hands throughout life 1 was shown that the impression in ink upon paper of each finger tip, contained on the average from twenty-five to thirty distinct points tained on the average from twenty-five to thirty distinct points of reference, every one of which, with the rarest exception, appeared to be absolutely persistent. Consequently that it was possible to affirm with practical certainty whether or no any two submitted impressions were made by the fingers of the same

person.

In the present memoir I shall explain the way in which finger
prints may be indexed and referred to after the fashion of a
dictionary, and on the same general principle as that devised by
A Berulion with respect to anthropometric measures, whose ingenious method is now in regular use on a very large scale in the criminal administration of France and elsewhere. I desire to show how vastly the practical efficiency of any such method as that of A. Berullon admits of being increased by taking finger prints into account in the way to be described.

larger pints into account in the way to be described. It must not, however, be supposed that the use of indexing finger marks is limited to the shore purpose, the power of doing so being equally needed for racial and herefathary inquiries I do not dwell upon these applications now, simply because I am engaged in making them, and the results are not yet ready to be published. I ought, however, to mention that a great increase published I ought, however, to mention that a great increase of experience has fully confirmed my earlier wears, that flagger of experience has fully confirmed my earlier wears, that flagger study owing to many distinct reasons. The impressions are easily to be made by anyone who has the proper appliances at hard. They are as darable as may other prested matter, and and clear, and their similar are made pendent of age and growth They are necessarily tra-tworthy, and no reluctance is shown in permitting them to be taken, which can be founded where upon one of the contraction of personal vanity or upon an unwillingness to communicate un-desirable family peculiarities

Without caring to dwell on many of my earlier failures to index the finger prints in a satisfactory way, my description shall be confined to that which has proved to be a success. It is based on a small variety of conspicuous differences of pattern in each of many digits, and not upon the numerous minute peculiarities of a single digit. My conclusions are principally based on a study of the impressions of all 10 digits of 289 different persons, but the tables given in the memoir refer only to the first 100 on my list. These are sufficiently numerous to serve as a fair sample of what we might always expect to find, while

they are not too cumbrous to print and to discuss in full detail Though I have spoken and shall speak only of impressions, it is not really necessary in forming an index to make any impression at all. All the entries that appear in it may be derived directly from the fingers themselves.

directly from the ingers inemselves. I rely, for the purpose of indexing, on the three elementary divisions of primaries, whoris, and loops. They are severally expressed by the numerals I and 2, 3 and 4, 5 and 6. The reason of this double numeration is that most of the patterns. reason of this double nimeration is that most of the patterns have a definite axis. Those that are formed by ridges which proceed from only one side of the finger, he in a sloping direction across its axis, the slope being directed according to the side from which the supply of nidges proceeds. All normal slopes, or chose that are (roughly) parallel to a line drawn from the tip of the forefinger to the base of the luttle finger, as well as all the patterns that have no definite axis, are expressed by the by the even numerals 2, 4, or 6. It cannot be too strongly insisted that the words right and left are ambiguous, and must not

be used here.

The forefingers are the most variable of all the digits in respect to their patterns, their slopes being almost as frequently

NO. 1128, VOL. 44]

abnormal as not, the third fingers rank next; the little finger ranks last, as its pattern is a loop in nine cases out of ten. I therefore found it convenient not to index the fingers in their therefore found it convenient not to index the fingers in their natural order, but so that the sequence of the namerals which express the patterns on the digits should be divided into two groups of three numerals, and two groups of two numerals. so 355. 455. 553. 55. The first group 355 referring to the first, second, and thred fingers of the left hand; the second group 455 to the first, second, and third fingers of the right hand, the third group 55 to the thumb and fourth finger of the left hand, the fourth group 35 to the thumb and fourth finger of the right hand. The index is arranged in the numerical sequence of these sets of numbers

these sets of numbers

Before translating the patterns into numerals, I find it an
excellent plan to draw symbolic pictures of the several patterns in
the order in which they appear in the impression, or in the fingers themselves, as the case may be, confining myself to a limited number of symbols [a list of those which have thus far sufficed number of symbols [a list of those which have thus far sufficed as given in the memor r, 50 them are symmetrical yearbols, and as given in the memor r, 50 them are symmetrical yearbols, and each pair being inclined to the right, and the other to the left. The total number of these heretylphs is consequently 3]. A little violence has of course to be used now and then, and the symmetrical transfer of the state of the st where the same reture does any for inferent soluting, as in the words at, ask, ale, and all. The ments of this process are many. It facilitates a leasurely revision of first determinations, it affords an adequate record of the character of each pattern, it prevents mistakes between normal and abnormal slopes, it prevents confusion when changing the sequence of the entries from the order of the impressions to that used in the index, and, lastly, it affords considerable help to a yet further subdivision of the patterns

In making a large and complete index, the symbols would, of course, be cast as movable types, and be printed with the letter-

It appears from the 100 cases that are printed in the memoir that there were 83 different varieties of index numbers when all 10 digits are used Consequently the average number of references required to pick out a single well-defined case from among these too would be equal to 100 divided by 83—that is, to about 1; I do not expect from my own relicrated experiences that there would be much trouble due to transitional cases, after a standard collection of doubtful forms had been collected and numbered. so as to insure that different persons should follow a common I find much uniformity in my own judgment standard

standard. I find much uniformity in my own judgment. Owning to the large effect of correlation, as mides based on all Compa to the large effect of correlation, as mides based on the large effect of correlation, as the large effect of the large ef

tion, or bad scars, or obliteration due to some exceptional cause tion, or bad acase, or obliteration due to some exceptional cause maybe reader of value. The three fingers of both hands are more than two cas useful for an index as those of one hand only, again, the three fingers of one hand a energy two cases as useful as a superior of the sound of the contract of

the same index number, in order to find a duplicate of a particular speciment, it is a very expelitions method to fix on some one well-marked characteristic of a mustle kind, such as in many present tisself in any one of the fingers, and in making the search to use a lens or lenses of low power, fixed at the end of an arm, and to confine the attention to selly to looking for that one characteristic. The cards on which the finger marks have been inside, may then be passed societatively under the lens with

uceu msos, may men ue passed successively under the lens with great rapidity. [It is proposed to exhibit specimens illustrative of this and of the previous memoir, together with appliances for taking impressions from the fingers, at the approaching sourie of the Koyal Society.]

Physical Society, May 22—Prof W E. Ayrton, F.R.S., President, in the chair.—Mr. C. J Woodward exhibited Dr. Schobben's form of lanters attereouspee, This instrument consists of a double lastern, by which the two pertures of a stereoscopic alide are projected on a screen. The two pertures are colored complementary time by planing pieces of red and green than the consistency of the project of th glass in front of the leases, and each observer views the over-lapping images intrough speciated, the eye-glasses of which are also coloured red and green. The atterescopic effect is very striking. Mr. Boys stated that he had treet to obtain a smillar result with the sid of polarized light, hy vaewing two polarized interesting the principle of the effect was obsained, owing to efficie oblistication produced by the screen, but he thought that it a deed gold cereft had been used instead of a nordningone, the effect might have been observed.—Prof Perry, F.R.S., showed a new form of steam-engine indicator. A galvanometer knowed a new form of steam-engine indicator. A gavanometer mirror is fixed excentrically to a steel disk, forming one side of a chamber communicating with the cylinder The pressure of the steam bulges out the disk, and causes the mirror to deflect a ray of light thrown on it in the ordinary way. A rotation of the mirror at right angles to the former is imparted by the movement of the at right angles to the former is impared by the movement of the putsor-tod. The ray of light trees, out the dangemen on a screen owing to the persistence of impressions. This indicator po-seess advantages over other form, he being free from errors due to friction or oscillations of the springs, and the alteration of continuous difference of the street of the street of the ordinary indicators are considerable at high speech, owing to the ripples introduced into the indicator diagram. If the natural period of the apprais a none-twentile of the time of a revoluperiod of the springs is one-twentieth of the time of a revolu-ion, the diagram is fairly free from ripples, but if it is as much as one-tenth, no amount of friction in the inductor will present pipples forming. In the new inductor, the natural period of removable, and can be proportioned to said different pressures and speeds. For experimental and testing purposes it is advant-ageous to see at once the alterations in the diagram caused by changes of lond, pressure, &c. Several diagrams were exhibited to the meeting. In reply to Trof Caru Wilson, Prof Perry stated that the defection was proportional to the pressure in the states that the deflection was proportional to the pressure in the cylinder within the limits any particular disk was intended for. Mr. Addenbrooke thought the instrument an important improvement on its predecessors, and considered it would prove of great service to electrical engineers. Mr. Swinburne said a peculiar ment of the indicator was that it could be permanently peculiar ment of the indicator was that it could be permanently standed to an engine lite an ordonary pressure gauge. He standed to an engine lite an ordonary pressure gauge. He The President thought that the instrument could be modified to as to be useful for analyzing the shape of the curves representing alternating currents.—On Blakedey's method of measuring letternating currents.—On Blakedey's method of measuring observed in transformers, by Prof. Perry, P. R. S. Thay paper to the fact that transformers show megnetic lexiage. The proofs of the formula hatherto given have been obtained by treating the equations in the manner first adopted by Dr. Hopkinson. On this system the reactions of the primary and secondary currents in system the reactions of the primary and secondary currents. are represented by the equations-

142

$$V = R_1C_1 + P\frac{dN}{dt}, \quad o = R_1C_2 + S\frac{dN}{dt},$$

where P and N are respectively the turns on the primary and secondary coals, and N is the magnetic flux between the coals. Here it is assumed that there is no magnetic fluxes, and the author thinks that on this account the method is inferior to the original method of fluxewell, for which the modesed electromotive induction. On the assumption that there are no eddy currents, Maxwell's equations are—

 $V = R_1C_1 + L_2C_2 + MC_3 + o = R_1C_0 + MC_1 + L_2C_3$ m which although L_1 , M_1 , and L_2 may not be assumed that they are respectively proportional to P_1^2 , P_2^2 , and P_2^2 if there is no magnetic leakage p_2^2 and if the amount of magnetic leakage least contain proportion to the whole that, the three quantiles may although the samurad proportional to each other decision M_1 and M_2 is the samurad proportional to each other decisions we obtain

$$VC = R_1C_1^2 - R_2\frac{M}{L_1}C_1C_1 + \frac{L_1L_2}{L_1} - \frac{M^2}{L_1}C_1C_1.$$

Hopkinson puts down the last term as zero, but owing to the very rapid rate at which C₁ changes, the last term is very im

NO. I I 28, VOL. 44

portant, even though M may be but a small percentage less than $\sqrt{L_1 L_2}$. On integrating this equation, the first two terms on the right-hand side yield Blakesley's formula, and the last term vanishes in the integral, because, however great the magnetic issalace may be supported by the property of the property of

$$\int C_1 \dot{C}_1 dt = 0,$$

when taken over a period because the functions are periodic. The Blackeep's formula this appears to fold, whatever the magnetic leakage. The paper contains several tables of calculations showing the effect of magnetic leakage on the value of the terms in the equation. Mr. Blackeep's and he doubted the correctness of the contract of

$$X = \frac{\int x A_{\rho} \int A_{\rho} dt dt}{\epsilon + \int A_{\rho} A_{\rho} dt},$$

where A, and A, are the instantaneous values of the primary and accondary currents, and a us with that N = N(t, i + 3) where N_s and N_s are the floxes of magnetism through the primary and secondary costs at the same misstal; it is a negligibly small excluding the primary and constant of the primary and the same that it is a simple to the primary and training this factor no assumptions whatever had been made, and twas casy to see that if A, and A, could be assumed size functions, and x a constant, the value of the factor N becames a timply. In only one case did N reduce to zero, and data was amply, and the same that the constant of the constant

Royal Microscopical Society, May 20—Dr. R. Brailhwate, Frendent, in the chair—The Peradent and the regetted to have to announce the deaths of two of their Honorary Fellow. Dr. Carl won Needle, of Munch, and Perd. J. Leddy, of Philaton and Perd. Peradent was the property of the companies of the property of the property of the property of the property upwards of an inch motion such way, and meetly required to be clamped on the pillar of the microscope when wasted for the hold recently manufactured by Zelst, which gave the hold recently made specially to meet the wasts of Dr. Van Heurck, of Antwerp. Mr Mayall, after criticising the desage, for which, be understood, Dr. Van Heurck was esponsible, for which the understood of the production of the increases exhibited. Mr. E. Mr. Nelson and the Rev. Dr. Dallinger also criticised the instrument adversely—Mr. Gernfell exhibited the photograph of a since the manufacture of the specification should have resulted in the production of the shall be produced to the production of the whether the vergetable or assimal in its nature. He also whished to meetion that in the Bonantical Gerdens, Regard's Part, there whether it was regetable or assimal in its nature. He also whished the production of the production of the production of the production of the two manufactures. If was remarkable for its childrons indica-

Claparède mentioned its having been found at Berlin, but hitherto it had only seemed to have been found in sca-water.— Fool. Bell said they had received a commanisation from Mr. J. Rossure describing the development of Tenna insecuelate from the duck, the system could form of which had not been some of the Copyria known to be instead with the parallel, and after some weeks opened the ducks and found the tapescommentioned. It was interesting to get the life history of another subject of lateral development in photography, and a paper on the use of monochromastic light in microscopy, and exhibited has model of a new and simple apparatus for obtaining a new projection microscope fitted will's a special condenser made of three first tennes on a to control the whole consecution of the control of the first tennes to at the control of the c Prof. Bell said they had received a communication from Mr The noverty arout it was the system of collecting the light, by which a beam of 41 inches was brought down to 11 inches, and by passing through two lenses placed in the water-trough, a beam of parallel rays of great intensity was obtained for use in projecting the image upon the acreen Afterwards Mr. Nelson gave an exhibition on the screen.

gave an exhibition on the second Geological Society, May 27—Dr A. Geikie, F.R.S., President, in the chair —The following communications were read:—On the lower jaw of Peocyptokin, by R. Lydelker After reviewing Sr. R. Owen's writings upon the large extinct Kangrovos for which he exhabitated the genus Procyptokin in 1874, the author describes two mandibular rams from the clay beds of Miall Creek in the neighbourhood of Bingers, N.S W which belong to this genus, and from their characters and a comparison of them with the lower jaws in the British Museum, he maintains that this part of the skull indicates two very dis-tained from sections exposed in gravel-pits and deep cuttings made for the purpose of laying down the main sewers, to show that Glacial deposits had been spread out to a much wider extent that Glacial deposits had been spread out to a much wider extent over the Hendon plateau than had hitherto been supposed, and that they had reached down the slopes to below the Ordinanc-datum line of 200 feet. He further mentions that there is evidence to show that these deposits have extended in a south was extent with the control of the control o and south west direction across the Brent and Silk Valleys, and and south west directions across the Breat and Silk Valleys, and one occur on most of the heights in the parabase of Kingsbury and Willisdem. As the sands, gravels, and lioulder clay which cover the Heisolon platest and the neighbouring heights are covered to the control of the same of of the sam erratics were deposited the believes that at this time there could have been no barrier of any importance to prevent these deposits from extending into the Thamnes Valley, and that the evidence clearly points to the conclusion that the implement-bearing deposits on the higher horizons in the Thames Valley bearing deposits on the higher horizons in the Thames' Valley found the classed as of contemporations used with the undoubted Glazail deposits at Hendon, Funchley, and on the alopee of the theorem of the contemporation of the contemporation of the theorem satisfact data man lived in the neighbourhood of the Thames Valley in the early part of the Glazail period, probably, the thinks, in pre-Glazial times. This paper led to a discussion, in which Mr. H. B. Woodward, Mr. J. A. Brown, Dr. Hinde, M. Mockelon, and the sauthor took part!

Mr. Moackton, and the author took part

Battomological Boclety, June _ Jum Frederick Du CangGodman, F.R.S. President, in the chair.—Br E. B. Foulton,
Godman, F.R.S. President, in the chair.—Br E. B. Foulton,
Godman, F.R.S. President, in the chair.—Br E. B. Foulton,
Godman, F.R.S. President, in the chair.—Br W. F. H. Blandford called
attention to the fact that the larve of Liferar mounts at remained
in small groups on the bark of the tree for about a week after
in small groups on the bark of the tree for about a week after
of by the German foresters to destroy them. Also that he had
hamfer ferified the statement that run and can be deceeded in
the Majdphinn tube of meets. Mr. McLachian, F.R.S.,
godes that the run of Majdphinn tubes were of
the part of Majdphinn tubes were of the flaggment tubes were of

the nature of renal organs was now satisfactory,-Mr. C. I. the nature of renal organs was low santiactory,—art. c. 1, of chann eshibited on opened to Colopper and the colopper of the co cause it to emerge at the same time as A, prodromaria -Mr Tuit also exhibited forms of Canadrina, some of which he said were considered distinct on the Continent, though they were not were considered assume on the Continent, trough they were recognized as such in this country, viz. Caradrina lat axacs (blands), C. superites, Tr., from Silgo, and C. superites, H. S. considered as synonymous with "aperites, Tr., but apparently more closely allied to C. ambigua.—Mr. Bristowe exhibited varieties of Arctia menthastirs, soons of which had been fed on varieties of Arctia menthastri, sone of which had been fed on mulberry and others on wintur, no difference was observed in the variation.—Mr G Elisha exhibited larws in their cases of Chelophora subsequentia and C maritmella—Mr, A G Butler communicated a paper entitled "Additional Notes on the Synonymy of the Genera of Noctula Monts"

Zoological Society, June 2—Prof W H Flower, C B., F R S., President, in the chair—The Secretary read a report on the additions that had been made to the Society's Menagerie during the month of May 1891, calling special attention to a female Water-buck Antelope (Cobus ellipsiprymnus) from British East Africa, presented by Mr George S Mackenzie, and to three Blanford's Rats (Mus. blanfords) from Kadapa, Madras, received in exchange, new to the collection
—Mr Sclaier made some remarks on the animals which he had noticed during a recent visit to the Zoological Gardens of Paris, noticed during a recent visit to the Zoological Gardens of Paris, Ghent, Aniwer, Rotterdam, Anisterdam, and the Higue—For Mewon, F. R. S., ethinized (on behalf of Part Suring, First received in Europe, representing the remarkable new Australian Mammal lately described by Prof. Suring as No. Language of the Notice Space, which was satisfed to be the Mole type of the largeter typhlops, which was stated to be the more type or une order Marsupala.—The Secretary exhibited (on behalf of Mr F E Hlasuw) specimens of the Long tailed 1:1, shot in Hol-land, and sent to this country for the purpose of ascertaining whether they belonged to the British form (Aerechta resea) or the white headed Continental form (I aectalan)—Mr. F Finn exhibited a hybrid Duck bred in the Society's Gardens, believed to be bred between a male Chilian Pintail (Dafila spinuauda) and a female Summer-Duck (.Ex. 17012)—A communication was read from Dr O. F von Moellendorff containing a revised list of the Land and Freshwater Shells of Perak, with descriplist of the Land and Freshwater Shelfs of Penk, with descrip-tions of some new species.—A communication was read from the state of the state of the state of the decision of the state of the decision of the state some of the Lesser Antilles, and deposited in the British Museum —A communication was read from Mr. Hamilton H.
Druce containing an account of the Batterfiles of the family
Lycanidae obtained by Mr C M Woodford in the Solomon

CAMBRIDGE

Philosophical Society, May 18—Prof Liveing, Vice-Prevident, in the chair — The following communications were made —On parasitic Mollusca, by Mr. A. H. Cooke —Mr. W. Bateson exhibited and explained models of double supernamerary pacetoil cambricu and explained model of condesupernametary appendinges in insects, and also a mechanical method of demostrating the system upon which the symmetry of such appendages is usually arranged —On the nature of the exercity processes in marine Polyzoa, by Mr. S F Harmer This communication was the result of an occupation of a University table at the Zoological Station at Naples during the Easter Vacation of 1891. Observations were made on the manner in which various arti-ficial pigments were excreted in Bugula and in Fluttra, on the lines adopted by Kowalewsky (Bholog Contrabillati, ix., 1389: 1390, pp. 33, &c.) for other invertebrates. The general result of the experiments was to show that exerction is not per-result of the experiments was to show that exerction is not performed by organs comparable with nephridis, but that this process is carried on by free mesoderm cells, and to some extent by the connective tissue and by the walls of the alimentary canal Evidence was obtained to show that the periodic loss of the alimentary canals leading to the formation of the "brown bodies" may be regarded as, to some extent, an excretory process.

PARIS

Academy of Sciences, June 1.-M. Duchartre in the chair.-Calorimetric researches on humic acid derived from sugar, by MM. Berhelot and André. The experiments show that hume acid is a polybasic acid which may be caused to unite with three equivalents of potash to form insoluble salts one selt the section of the se described as monobasic, stable, and formed with the evo at the hottest hour in the day —On Abelian equations, by M A
Pellet —On a new method of determining the vertical motion o acrossals, by M André Duboin The methods usually employed by balloonists to describe the control of the methods usually employed by means of a barometer, or by throwing out light bits of paper by means of a harometer, or by throwing out light bits of paper and obsering whether they ascend or descend relatively to the halloon. The author has develed as apparents having the action of the ac over it wo ame plates. A cell this constituted is shown to be practically constant for three or four days, and it said to work for years without getting out of order.—Determination of holder weights at the critical point, by M. Philipple. Guye Using Van der Waals's formula, the author deduces the constant of the cons

 $d = 1146 \frac{60}{\pi (1670 + \theta)}$, where d is the critical density with respect π (1070 + 9) to air, δ the critical density with respect to water—that a_i the weight of the substance in grams occupying a volume of one cubic centimetre at the critical state— δ the abolute temperature, and π the pressure in atmospheres. It is then shown the values of d obtained by means of this empirical formula the values of a cotained by means of this empirical rormans me equal to the molecular weights of the substances investigated divided by 28.87—Research on the separation of metals from platinum, and in particular of palladium and rhoduum in the presence of common metals, by MM. A. Joly and F. Leidet. The platinum or palladium are converted into soluble intrites by the addition of potassium nitrite, and are thus separated from other metals—On the specific heals of some solutions, by M. W. Timofeiew Alcoholic solutions of bichloride of mercury W. Timofeiew Alcoholic solutions of bichloride of mercury and cadmium todide were used. It is shown that the difference between the molecular specific heat of the solution and solvent is sensibly equal in the case of both salts, the mean value heing 52. Taking this value to represent the molecular specific helt of the salt in solution and the specific heats of the alcohols employed to be expressed by the formulæ.

Cuethyl = 0'56755 + 0'001633/ , Cethyl = 0 53574 + 0 002132/; it is shown that the observed and calculated specific heats of the it is shown that the observed and calculated specific heart of the solutions are very nearly the same in each case.—On the oxidation of the control of the property of the control of the principal derivatives of uncontrol of the principal derivatives of the desired of the desi phine and codeine was suggested by M. Lafon in 1885. The author shows how the method can be extended to other alkaloids. ambor shows how the method can be extended to other alkaloids.

—On the development of the liver of Noldbranchausts, by M.

H Facher The research shows that the liver of Noldbranchausts, by M.

H Facher The research shows that the liver of Noldbranchausts is formed to a great extent by the left hepatic bode of the embryo, and that the hepatic togans in two very different groups of Models and the hepatic togans in two very different groups of Models and the hepatic togans in two very different groups of Models and the hepatic togans in two very different groups of Models and the hepatic togans and the hepatic togans and the coacheaust of the ockchaeft, by M. Alfred Gard.—The genera of the group of the class, and in particular the genum Fravmint, by M., I vegue

—On some supporting elements of the leaves of Decotyledons, by M. E. Ferlaw—Diffusion of three distinct forms of transmit model in the Cristice after the support of the class of the c

treating chalk with an acjd, leads the author to believe he have recognized the three crystelline forms of thanism oxide—ruble, anatase, and brookle—The lichens on multerry-trees, and their influence on silk enlure, by M. G. Hallauer—On the employment of carbon bushphide against settal parasites, by

AMSTERDAM

Royal Academy of Sciences, May 30.—Prof. Van de Sande Bakhuyen in the chart.—Dt. Bakhusia Roozsboom stander Sciences, May 30.—Prof. Van de Sande Bakhuyen in the chart.—Dt. Bakhusia Roozsboom stander Admitting the abboults bhomogeneity of aboth crystalis, according to the recent researches of Reigen, it is possible to according to the recent researches of Reigen, it is possible to deduce, by thermodynamical reasoning, that, when y and T are taken as constants, equilibrium in obtained when to a proportion a fit the components in the manded crystals, correspond two definite of the components in the manded crystals, correspond two definite or the components in the manded crystals, correspond two definite or the components of t of the components in the mixed crystars, correspond two deninic values C₁ and C₂ for the concentrations of the components in the aqueous solution. From the analogy between the said equilibrium and that between a liquid and a gaseous phase, composed of two substances, are further deduced some general composed of two substances, are further deduced some general conclusions at on bolismon of two stomorphous value when they are evaporated. This is done both for the case which they are evaporated. This is done both for the case which they present in times. I he latter was found in studying the solubility of KClO₂, and TClO₃. So the mixtures were obscured, at ro and 1 am from 0–3, and from 9) 9–100 per cent KClO₃. In the evaporation of any one solution, it tends on composition, which is necessary in deposit the two kinds of crystals between which the higtus exists

Grystab between which the hasta exists

BOOKS, PAMPHLETS, and SRRIALS RECRIVED

Bacters and their Produce. Dr. von Woodband (Sout) — Endelines in

Groundwise, West, Wes

CONTENTS.

Mammale Living and Extinct By Prof E Ray Lankester, F.R.S.

Forty Years in a Moorland Parish

DACE

121

122

124

124

Our Book Shelf -
Lowne . "Anatomy, Physiology, Morphology,
Lowne . "Anatomy, Physiology, Morphology, Development of the Blow fly "-L C M
Brinton . "Races and Peoples Lectures on
Science of Ethnography"
Letters to the Editor -
Crystals of PlatinumJ. Joly
Porpoises in the Victoria Nyanza Dr. P.
Sciater, F R.S.
The Loological Station at Naples - W P
Sladen
A British Institute of Preventive Medicine .
Earth-Currents and the Electric Railway.
truted) By William Ellis
The Annual Visitation of the Royal Observator
The Classification of the Tunicata in relation
Evolution. By Prof W. A. Herdman
Photo-Stellar Spectra By Rev. T. E. Espin
Some Aspects of Stas's Work. By V. C
Notes

The Flora of Diamond Island. By W. Botting Hemaley, F.R.S.

THURSDAY, JUNE 18, 1891.

EGYPTIAN IRRIGATION.

THE "Note" on the above subject by Sir Colin Moncrieff, which we publish this week, will prove pleasant reading to all who have the welfare of Egypt at heart. To those who have known that country intimately in the past, the brief record of progress in irrigation since the British occupation will recall the horrors of the corude, and the torturing of the wretched neasantry by tyrannical farmers of the taxes; and to engineers the record will imply, not only that all those atrocities have been abolished, but further that some of the most difficult and important engineering problems of recent times have been successfully solved by Sir Colin Moncrieff and the able staff under his control. Nothing is exaggerated, but we have in the "Note" a plain and modest statement of the quiet and unostentatious execution of works the mere discussion of the difficulties of which had occupied the time of the predecessors of Sir Colin for the previous quarter of a century without anything useful resulting

It will be only necessary to refer to one or two matters to establish this proposition In paragraph 10, Sir Colin announces that the Barrage has been completed, and placed in a condition to fulfil its original purpose, for the sum of about £460,000 Contrast this with the published statement of M. Linant, a former engineer-in-chief of the Egyptian Government, who, in 1872, expressed a doubt whether it would not cost more to repair the existing Barrage than to build an entirely new one, and further says: " If, at the time when the Barrage was commenced, steam-engines had been what they are to-day, one would certainly have advised Mehemet Ali to abandon his project of a Barrage for the establishment of pumpingmachinery " Even at that time, M Linant thought it was not too late to consider whether it would not be better to abandon the idea of repairing the Barrage, and to assist in the determination of the question he submitted an estimate of the cost of pumping, amounting to £465,000 per annum, which, he thought, the cultivators could well afford to pay

We have already stated that Sir Colin Moncrieff has effected the same result by a single expenditure of £460,000 Instead of by an annually recurring one of £465,000. By means of the completed Barrage the whole summer supply of the Nile is thrown on to the lands, so obviously there is no work for pumps, and the vast cost of the same is saved to the country Although national feeling runs high in France, we cannot but think that French engineers will rejoice that the world-renowned Barrage of the Nile, the design of which by M. Mongel was approved of by the Council of the Ponts et Chaussées in 1842, and carried into execution during the ensuing ten years, has at last, after thirty years' practical inutility and failure, been finally completed by their worthy compeers and successors in Egypt-the British engineers-whose experience, gained in the great trugation works of our Indian Empire, has been as zealously utilized in securing the success of a great French work as it would have been in carrying out a new one of their own design.

One other matter in Sir Colin Moncrieff's " Note " may be referred to-namely, the drainage recently effected No doubt, the fact enforced upon Indian engineers by. numberless experiences-that high-level perennial irrigation must be accompanied by drainage works if soil and people are to remain in a healthy condition-was not well known to the French projectors of summer irrigation works in Egypt, and, as a consequence, whereas magnificent canals carrying 5000 cubic feet and upwards per second were constructed, no corresponding means were provided for draining the superfluous and often saline water off the lands Sir Colin tells us that the mileage of the drains at present is not less than 1500 When we consider that, in addition to these vast works of improved prigation and drainage, a steady reclamation of marshland has been going on, we have reason as a nation to be probd of the good work which our countrymen have carried on in Egypt, as, whatever may happen in the future, the fact of the British occupation will, from its successful applications of science, be indelibly stamped upon the face of the country for all time, and its memory will for other reasons live honourably in the traditions of the emancipated and much-enduring fellaheen

PHYSIOLOGICAL PSYCHOLOGY.

Leitfaden der physiologischen Psychologie. In 14 Vorlesungen Von Dr Th Ziehen, Docent in Jena (Jena: Gustav Fischer, 1891)

"HIS little volume will be welcome to a good many students of psychology, both in Germany and beyond. Anyone who has had to look up the newer researches in experimental psychology in Germany knows the serious difficulty of gaining easy access to them They are scattered over a whole heterogeneous mass of serial and other publications. Now we have to look into an avowedly psychological journal or brochure, but more frequently still into physiological works, and not infrequently into journals for psychiatry. The explanation is obvious. Psychology, in passing into the objective and experimental phase, is broadening its base to an almost perplexing extent, and is encroaching more especially on the domain of physiology. Hence the need of a volume like the present work, which aims at giving the beginner a conspectus of the psychological field. We want such a book badly in English, the only available one, that of Prof. Ladd, being at once incomplete on certain sides, and in part too metaphysical. Meantime we can recommend Dr. Ziehen's "Vorlesungen" as exceedingly well adapted to give the student a clear idea of the scope and the methods of the new science of physiological psychology.

Dr. Zieben marks off physiological from what he calls transcendental psychology by the differents that it deals with psychical processes as attached to cerebral functions. Psychophysic, the branch of investigation opened up by Weber and Fechner, he includes under physiological psychology as that part which alims at exact measurement. This seems to be a satisfactory way of mapping out the ground. The standpoint of the physiological psychologists is Indicated in the assumption that every psychical process must be thought of as having a concenniate hypological sums to place the process of the psychologists of the psychologists.

process. This, too, though it would exclude such a physiological psychology" as that of Ladd, seems a reasonable way of viewing the matter Further, the author proceeds to set forth the typical form of psychophysical process as reflex, and he considers that every known development of the psychical phase must be capable of being viewed as an incident in such a reflex process. Here Dr. Ziehen meets the real difficulty in psychology, and, as we see, meets it holdly. From the physiological point of view we are bound to take the reflex as our starting-point, and to view the most intricate plexus of cerebral processes as merely an expansion of the intermediate central stage of this reflex. But can the same mode of treatment he applied to the intricate interweavings which constitute our mental life? As mere events in time, synchronizing with neural events, they appear to be susceptible of being thus regarded, and this, as the author rightly contends, is precisely the way in which the physiological psychologist has to conceive of psychical phenomena.

146

Starting, then, with the reflex, of which the writer gives an admirable account by way of introduction, he proceeds to deal with the psychical process in its three successive stages, viz sensation, answering to the afferent or sensory section of the nervous process, ideation, or, as he puts it, association, answering to the expanded form of the central section; and action, answering to the efferent or motor section. The account of sensation is fairly full. and up to date. Perhaps the treatment of the relation of stimulus to sensation (Weber's law) is proportionately too long The discussion of the interpretation of the facts is original and interesting. The author does not like most recent physiologists, view the logarithmic ratio of stimulus to sensation as a purely physiological relation. due to what Mr James has recently called the friction of the nerve-machine, but connects it with a more general psychophysical law formulated by Hering, viz "that the purity, distinctness, or cleamess of a sensation or idea depends on the relation in which the weight of the same, ie the magnitude of the corresponding psycho-physical process, stands to the collective weight of all simultaneously present sensations and ideas, r.c. to the sum of the magnitudes of all the corresponding psycho-physical processes" At the same time the author is far from clear when he speaks of the conscious comparison of intensities as an "associative activity." This is an example of a tendency among the younger physiological psychologists to force psychical processes into a physiological framework. Comparison cannot, as Munsterberg's ingenious but futile attempts plainly show, be regarded as merely an associative process, though of course it depends on association, and in this way can be correlated with a nervous process. It must, however, be said in justice to Dr. Ziehen, that he is commendably free from the common tendency of physiologists to ignore psychical distinctions. Thus it is quite refreshing to find a physiologist contending that black and grey are positive sensations, having each its distinctive quality, like white or blue. It may be added that special interest is given to the exposition of sensation, as of the other psychical phenomena, by the frequent bringing in of the biological point of view, and the suggestion how, by the process of natural selection, particular psycho-physical

arrangements have been brought about and rendered permanent.

The account of sensation is supplemented by a chapter on the affective or emotional tone of sensations, i.e. their pleasurable or painful aspect Here, again, we have frequent references to the Darwinian theory, as when it is suggested. d propos of the fact that extreme intensities of skin-sensation, pressure, heat and cold, lose their distinctive sensational quality, and become purely affective phenomena or pains, that this arrangement has come about owing to the circumstance that in the evolution of the zoological series "intensive mechanical and caloric stimuli constitute the earliest, the most frequent, the most direct, and the greatest danger to the animal organism' (p 85) The author refers the whole of the difference in affective tone among colours, and among combinations of musical sound, to association. This seems to be going too far The contrast between the exhibitanting effect of the warm colours, and the quiet effect of those at the violet end of the spectrum, seems to be connected in part with the difference in the underlying nervous processes, and this is certainly true, as Helmholtz has shown, with respect to the emotional aspect of certain accords, eg the major and minor triads.

Coming now to the account of the idea (image and concept), we note that Dr Ziehen differs from the majority of contemporary psychologists in assigning a separate cortical element to the sensation and to the idea. These different cells (the author, in spite of Lewes's attacks on the cell-superstition, talks of the individual cell as the seat of a sensation) are closely connected, and in this way the after-effect of sensations in memory, as also the reflex effects of ideas in exciting sensations, as in hallucinations, are accounted for. The writer elaborates his peculiar anatomical hypothesis in an ingenious way. He seems to admit, however, that it is a pure hypothesis, for the facts of "mental blindness" referred to are not apparently put forward as a proof, and it may be added that rightly viewed they do not seem even to suggest the hypothesis. One may add that it appears to lack the only possible justification of such a hypothesis, viz. that it simplifies the interpretation of the facts. The other supposition, that the sensation and the idea involve the same group of central elements (not the same single cell). is more reasonable in itself, and seems to offer a readier explanation of most of the phenomena

The account of the psycho-physical process in association is less clear and instructive than most of the exposition. The author follows Munsterberg a good way at least-in reducing all association to one form, viz. contiguous, and more particularly simultaneous, association, But the diagrammatic representation of the processes strikes one as needlessly complicated by the hypothesis of separate ideational nerve-cells. Much better is the account at the close of this lecture of the way in which the different psycho-physical factors co-operate and modify one another in the actual concrete processes of reproduction. Dr. Ziehen is particularly happy in explaining the great variability of the sequences of our ideas from moment to moment. The account of the ideational stage is completed by a discussion of the relation of association to judgment and reasoning-which is a little

. 1.5

hasty, and ignores some of the main difficulties of the subject, of attention and the voluntary control of the thought-process, and of the abnormal modifications of ideation in mental disease, sleep, and hypnosis.

The unfolding of the third and final stage, voluntary action, with which the volume concludes, offers little that is noteworthy. The author adopts the new and growingly fashionable view that all our active consciousness, sense of muscular effort, and so forth, is the result of afferent nerve processes, and he proceeds, much in the manner of Munsterberg, to resolve all volitional processes into complexes of sensations and ideas, more particularly ideas of movement This seems to lead logically to the denial of any distinctive active or volitional psychosis answering to ideational or emotional psychosis, and Dr. Ziehen is not afraid to express this denial, and fortifies his position by the debatable statement that psychiatry, while acknowledging a special variety of intellectual and of emotional disturbance, knows no such thing as a distinct volitionary disturbance. It is to be added that the exposition concludes with a particularly good discussion of the final results of psycho-physical research The author here shows himself a genuine psychologist, and while insisting upon the invariable concomitance of a physiological factor in psychical phenomena, is so far from regarding the psychical as a non-essential and negligible accompaniment of the material process, that he closes in a quite Kantian strain by reminding us that the psychical chain is that which is known primarily and immediately, and which as such must always possess more reality for us

ACHIEVEMENTS IN ENGINEERING

Achievements in Engineering. By L. F. Vernon-Harcourt, M.Inst.C.E. (London: Seeley and Co, Limited, 1891.)

THE object of this book is to describe some of the principal engineering works carried out during the last fifty years at home and ahroad. The author has avoided technical phraseology to a great extent, thus making a very interesting subject as clear as may he to the general reader. Much subject-matter has been gleaned from many sources, and these are amply enumerated in the preface.

The London Metropolitan Railways and the New York elevated railways are described in chapter i growth of the Metropolitan system is very interesting, and is traced from the opening of the first section from Paddington to Farringdon Street in 1863 to the completion of the "Inner Circle" from the Mansion House to Aldgate in 1884. The author states that when the Metropolitan Railway was first designed, it was intended that the traffic should be worked by smokeless, hot-water locomotives not burning fuel, as it was supposed that the trains would be small, and that "foreign" locomotives would not travel over the line to any important extent This, however, was not carried out, and locomotives of the ordinary type were adopted. The ventilation therefore proved defective, and even to this day improvement is greatly needed in many sections. The bad atmosphere is, of course, due to the locomotives in use, and the emission of steam considerably adds to the nursance

NO. 1129, VOL. 44]

Locomotive engineering is surely able to cope with this trouble. The fead weight of the trains might be considerably reduced with advantage, and the engines designed with ample condensing arrangements, even if the latter had to be attached to the engine as a separate vehicle. The boilers should, of course, be large enough to steam well with the ordinary blower, so that all the exhaust might be condensed.

147

The Metropolitan Railway represents an engineering achievement novel in many respects and made under circumstances of peculiar difficulty On the other hand, the New York elevated railways illustrate how the American engineers solved a similar problem in a very different manner Owing to the cost of "burrowing underground," as the author aptly describes it, they resected the underground scheme, and for the same reason a railway on an arched viaduct was also considered The railways have been carried along the undesirable streets, raised above the street traffic on girders resting upon wrought iron lattice columns standing at convenient places on the line of the curb of the pavements. An illustration is given representing a street in New York and the elevated railways running on each side payment has been made for placing these columns along the streets, and no compensation has been paid for damages to residential property fronting the railways The author estimates the depreciation in value, due to the presence of the railway, as not less than 50 per cent. The cost per mile will therefore be considerably less than in the case of the London Metropolitan Railway, in which case all these items were heavily paid for. The London railway cost about £575,000 per mile, whereas the New York elevated railways only cost about £81,000 per mile.

Chapter II describes railways across the Alps, the Rocky Mountains, and the Andles. On p. 50 we find an incresting diagram representing the gradients and altitudes of the heavy portions of these lines, from which it is evident that the lines in North and South America are at higher elevations and are more subject to snow than the highest of the Alpine railways, and more severe gradients are to be found. Take, for instance, the heavy gradients are to be found Take, for instance, the heavy miles, the maximum gradient being it in 25. This portion of the line is worked by Fairlie engines, which the author attempts to describe on p. 56

The author in describing the Festiniog Railway says that the traffic is worked up the long incline by "duplex bogie engines, introduced in 1869, having two engines, united by a tender common to the two, and hinged at the centre." He goes on to say that these are called Fairlie engines, after the name of their designer. The Fairlie engines as used on the Mexican Railway certainly do not agree with this description, nor does this description agree with the usually accepted type of engine known as the "Fairlie." The Fairlie engine consists of a special type of boiler carned on bogies, one at each end These bogies have either four or six wheels, as the case may be : each bogie is fitted with steam cylinders and gear complete, and all the wheels are coupled. The boiler has a smokebox at each end, and is fitted with fire-boxes in the centre, being fired from the side. The steam pipes from the boiler to the "steam" bogies are flexible, to allow the bogies to take the curves. The water is carried in side tanks, and the fived no the top of the boller and at the side. The author will observe that there is no central pived and no tender; the engine is a take engine; and that the whole of its weight is good for adhesion. The Fairlie engines at work on the Mexican Railway weigh in order about 92 tons. The total wheel base is 32 feet 5 inches, and the raid wheel base of the boors is 8 feet 3 inches.

148

Chapter III. includes narrow gauge railways, as well as the Fell, Rigi, Pilatus, and Abt mountain railways. The use of a narrow gauge railway in place of the standard gauge is due to questions of cost of construction by diminishing the width of the line, and also enabling sharper curves to be adopted Narrow gauge railways now in use were years ago of ample capacity for the traffic then available, but are now a continual source of trouble where the traffic has increased beyond their canacity In some cases, where an increase of gauge is impossible owing to the cost, the rolling stock has to be designed to suit the abnormal requirements, and the locomotives recently designed have to be made to suit the conditions. and are working under adverse conditions from a locomotive engineer's point of view. The cost of a break of gauge is a serious matter, involving as it does the transshipment of passengers and goods, as well as two classes of rolling stock. In India, for instance, the metre gauge has given place to the broad gauge of 5 feet 6 inches in many cases, in order to obtain through communication without break of gauge The author gives an excellent description of the various mountain railways named, and they are without doubt monuments of engineering daring and skill

In chapter wan excellent description is given of the piercing of the Alps. To the ruralry of European Powers, each anxious to command a route, are due the several Alpine tunnels; from the design and execution of the Mont Cennis tunnel to the more recent schemes west of the S. Gothard. Had the author told us a bittle more about the difficulties encountered, he would have added considerably to the interest.

Tunnels under the Algs naturally give place to subsqueous tunnels in the sequence of subject-matter in the volume. The Mersey and Severn tunnels are described, and the tremendous difficulties encountered in the execution of the latter undertaking are pointed out. We also find a description of several subaqueous tunnels in the States, including the Sarma tunnel recently opened under the St. Clair river, to connect the Grand Trunk Rallway of Canada at Sarma with the United States Rallways at Port Huron. The chapter closes with an account of the proposed Channel Tunnel.

The progress and principles of modern bridge construction are treated in chapter vi. This gives a good account of the great advance made during the good account of the great advance made during the last fifty years in this important branch of engineering. Wrought-iron gradually superseded cast-iron in bridge construction, and steel has again superseded it. The manufacture of steel has now reached a stage in which there are no uncertainties in its quality. The earliest instance of the adoption of steel for a bridge is the St. Louis Bridge, over the Mississippi, constructed in 1867–74, and the most recent example is, of course, the cantilever bridge, with two spans of 1700 feet, over the Firth of

Forth The author gives the great Indian bridge over the Rom branch of the River Indian, as Stukkur, very little notice, and does scant justice to this "achievement in engineering," certainly a monument to its designer. Designed by Sir Alexander M Rendel, K.C.I.E., M Inst.C.E., and built by, and erected on the works of Messrs. Westwood, Baillie, and Co., of London, this bridge was taken to pieces and shipped to India, where it was re-erected. The chapter closes with an account of the proposed bridge over the Change over t

Submarine mining and blasting are treated in the chapter that follows. This chapter is interesting mainly owing to a detailed description of the operations for improving the entrance to New York Harbour by the removal of the obstructions at Hell Gate and Hallett's reef. With reference to the explosion at the latter site, it is interesting to observe that the earth-wave produced was carefully recorded at various places, and the rate of transmission of the shock was found to be more rapid and more uniform when the shock passed northwards through rock, than when it passed through drift in an easterly direction. In travelling through drift, it reached Goat Island, a distance of 145 miles, in 59 seconds, and Harvard College Observatory, 1823 miles, in 3 minutes 40 seconds; and in travelling through rock, it reached West Point, 424 miles distant, in 11 seconds, and Litchfield Observatory, 1741 miles away, in 451 seconds.

Chapters ix. to xv. deal with that branch of engineering which may be roughly included under the title of "Harbours and Docks." In a previous work by the author, bearing this title, and reviewed in these columns, this subject was amply dealt with, and it will now be sufficient to state that the present chapters are well up to the standard of excellence of his previous work. We find an interesting description of the Manchester Ship Canal works in these chapters-a work rapidly nearing completion, and one which, if successful, will be the forerunner of many similar works in this country An illustration is given, showing the progress of the works forming the Eastham Locks, viewed from the Eastham end. This illustration gives a very good idea of the magnitude of the undertaking. Another Manchester undertaking occupies considerable space in this work, viz. the Manchester waterworks, and more particularly the Thirlmere scheme. The author tells us that the eventual maximum daily supply of 50 million gallons of water will be conveyed to Manchester by an aqueduct, or conduit, about 100 miles long. Another similar undertaking is also discussed; in the Liverpool Vyrnwy scheme we find how engineers have solved the difficulty of getting a pure water supply for that city,

The volume concludes with an account of the Eddystone Lighthouse and the Eiffel Tower.

The frontispiece is a portrait of Robert Stephenson, a way appropriate one for such a work. His name will ever be associated with the development of railways, as the author remarks, and he might also have pointed out that the railway has been in many cases the reason for many "achievements in engineering" being called into existence.

Taken as a whole, this work is a very interesting one. It is well written, and the author may be congratulated on having succeeded in his endeavour to describe briefly some of the principal engineering works carried out, at home and abroad, within the last fifty years. The book is well printed, and the illustrations are excellent, although there might perhaps have been more of them, considering that the general reader has to be provided for.

N. J. L.

GEOLOGICAL EXCURSIONS.

Geologists' Association: a Record of Excursions made between 1860 and 1890. Edited by Thomas Vincent Holmes, F.G.S., and C. Davies Sherborn, F.G.S. (London: E. Stanford, 1801.)

THE Geologists' Association began its useful career of work more than thirty years since. It has stimulated-more, perhaps, than any other body-a real interest in geology among those who live in and about London, because it has enabled students, still near the outset of their work, not only to meet for mutual help and encouragement, but also to be aided by those of repute in science Of its meetings, not the least pleasant and useful are the excursions. At first these were made generally once a week, so long as weather permitted, and they occurred a Saturday afternoon or at most a single day. Then an occasional journey of longer duration was attempted : now it is usual to undertake excursions, lasting two or three days, at Easter and Whitsuntide, and one of a week or more during the summer holidays Before each excursion a flysheet is issued to the members with a brief description of the geology of the locality, illustrated by diagrams and containing references to books and papers Afterwards, a report of the excursion is inserted in the Proceedings of the Association It was a happy thought to collect together in one volume these scattered notices, for they give succinct descriptions of almost all the localities of geological interest readily reached from London, so grouped as to be conveniently accessible. Thus the student, instead of having to compile for himself, from books or maps, a plan of campaign. whether for an afternoon or for a longer time, finds everything arranged ready to his hand, and is directed to the sections best worth visiting. These diagrams and reports possess a further value, that they frequently record sections which can be no longer examined, because they now either are overgrown by vegetation, or have been removed in quarrying The work therefore is a geological guide-book of an exceptional and a very convenient character to a large district around London, and to several other localities of special interest in England.

The plan which has been followed in compiling the volume is stated in the preface. The excursions are grouped, as far as possible, within county boundaries, where more than one use has been pard to any place, the editors have "either suppressed the shorter, and retained the foller, or given from each account that which is not to be found clawshere." The reports have been condensed by the excussion of matters of general or merely temporary interest, and although references are made to all excursions up to the year 1890, no reports are given of later dates than 1884, because since 1883 it has been customary to print all these in the November number of the Proceedings, so that they can be easily consulted

NO. 1129, VOL. 44

The thanks of the Association-indeed of a wider circle of geologists-are due to the editors for the pains which they have taken in discharging a very laborious duty It seems almost ungracious to criticize, and to do it effectively would require encyclopædic knowledge; but we think that, though it may have been "impossible to send each report to the original reporter for revision," it would have been prudent to submit it to someone with a special knowledge of each district. These reports occasionally contain obiter dicta, or the crude speculations of members who are better acquainted with their own locality than with the principles of the science Hence obsolete notions are preserved like flies in amber: these may perplex, but they cannot help the beginner. By way of testing the results of the editors' method, we have examined the reports of two or three districts with which we are specially familiar. The statement on p 203 about the section at Roswell Pit, near Ely, is misleading The natural interpretation of its words would be that the Kimeridge clay formed a part of the great erratic This, in reality, consists of Cretaceous rocks, the Jurassic clay being in situ. On p. 216, the sentence "at the base, as at the top of the Gault," should have been "below the base, as above the top." Again, the clay beneath the neighbouring Upware limestone, now admitted to be Coral rag, cannot well be Ampthill clay, and we are not aware of any evidence in favour of this view Again, the account of Charnwood Forest needs correction At p 463 a statement is quoted, which was published without due authority, and has been recalled by the author. On pp 465 and 466 the suggestion that the Charnwood Forest rocks "ought to be called Laurentian" should have been cancelled. It was groundkss, even as Laurentian was defined in 1875 it is absurd now All reference to the "Archæan Petrology" of Prof. Ansted might well have been omitted On p 472, Peldar Tor is twice misprinted Peddar Tor We know of no ground for the statement, on p 473, that "the quartz [m the rocks of this neighbourhood] appears to be of subsequent formation," Doubtless similar defects could be pointed out by others : indeed, our own list is not quite exhausted, but we have no desire to carp at a book on which so much labour has been bestowed, and prefer to welcome it as a valuable addition to British geology, which will be indispensable to all students who live in the neighbourhood of the metropolis T. G B

OUR BOOK SHELF.

Across East African Glaciers: An Account of the First Ascent of Kitmanyaro By Dr Hans Meyer Translated from the German by E. H. S. Calder. (London: George Philip and Son, 1801)

LON. before he thought of exploring any part of Africa. Dr. Meyer was an experienced and exhimisative traveller. The idea of undertaking explorations in "the Dark Connent" was suggested to him by the fact that while the German colonial possessions in the west of Africa had been thoroughly investigated under Government supervision, and at the Government expense, those in the East had been left to the more limited resources of commercial companies. It occurred to Dr. Meyer that himself to the task which the German Government seemed so uswilling to undertake Accordingly, in 1886, he began to make preparations for the accomplishment of his plan

and since that time he has organized no fewer than three important expeditions, in the third of which he succeeded in reaching the top of Kilimanjaro. It is this third expedition of which an account is given in the present work. The broad results of the journey were soon made known : but of course it is only from th explorer's full narrative that an adequate idea can be formed of the interest and importance of his achieve-ments. The mountain mass of Kilimanjaro towers up to a height of nearly 20,000 feet, and Dr. Meyer describes well the feelings with which he saw it after his arduous march across the steppes "It was a picture," he says, "full of contrasts-here the swelling heat of the equator, the naked negro, and the palm-trees of Taveta—yonder, arctic snow and ice, and an atmosphere of god-like rearcue snow and ice, and an atmosphere of god-like re-pose, where once was the angry turmoil of a fiery volcano." The story of the ascent is told most vividly, and there are few readers who will not sympathize with the delight with which he speaks of the moment when he set foot on the culminating peak Although the record of his ex-periences at Kilimanjaro forms the centre of the book, he has much to say about what he saw both on his way to the mountain and on his way back; and in appendices various writers present classifications of his collections, and the conclusions at which they have arrived in working out his astronomical and meteorological data. The book is admirably translated, and its value is greatly increased by illustrations and maps.

150

Chemistry in Space From Prof T H van 't Hoff's "Dix Années dans l'Histoire d'une Théone" Translated and Edited by J. E. Marsh, B.A. (Oxford: Claren-don Fress, 1891.)

WE have already reviewed the monograph of which this is a translation (NATURE, vol xxxvii. p. 121), and need not therefore, at present, say anything of the subject with which it deals. The translator has done his work carewhich it death. The maintain has done his work card-fully, and "the invaluable assistance and advice" of the author have enabled him to make his rendering "a con-siderable extension of the French edition" Mr Marsh advises those to whom the question is new to leave the first chapter till the end, as it contains a translation of the earliest memoirs on the subject, and the ideas are incompletely developed, obscure, and sometimes erroncous.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions ex-peried by his correspondents. Neither can he undertake to return, or to correspond with the worter of, rejected manuscripts intended for this or any other part of NATURE. No notice to taken of anonymous communications.

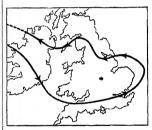
Erratic Track of a Barometric Depression.

Erratic Track of a Barometric Depression.

This angular course of the cycloid system which has, during the wesk terminating on May 29, circulated round and across the British Islee, deserves more attention than can be thus early green to it. I with here, with your permission, first, to describe the path fits centre as correctly as can be done with the principal modifications of the stohars and of the weather in the neighborhood of the centre; secondly, to mention some remarkable facts in relation to the upper currents as observed by mayelf in its neighborhood; and finally, to indicate the believe, in the instance before mis, prove to be of most scientific value.

value. (1) The accompanying chart shows the course of the centre of depression, so far as we have yet been able to follow its track; the arrow-beads marking the position at 6 p n., of each day. At 8 a.m. of the 2yrd, the centre appears to have also about the matter of the war of Erris Head, with a baron-day pressure of a little before 2y2. By 6 p.m. it had defined the contraction of the con

English miles per hour, and by 8 a.m. of the sath to a little west of St. Anne's Head. During the above period the depression was clongaring listle, the position of its major axis changing from N.W.-S into W.-E. The weather in the meantime was made to the state of ward, having moved during lie twenty-four hors with a velocity of 10 miles per hour. By the moning of the 26th the centre was near the mouth of the Humber, nainfall continuing over the mouther of the period of the centre of th circular in form, and the central pressures slightly decreasing. During this day rain and cloud prevailed on the west of the system, while in its rear there were some scattered thunder and hall



showers of the type prevalent in summer in the rear of cyclonic systems travelling to nonth-east. At 6 p.m. on the following systems travelling to be shown that the system of the system had almost left our shores, finer weather setting in over Great almost left our over Great system had Britain generally.

(2) The point marked with an asterisk on the chart marks

An of the position of the propers of the depression, a position of vanings for the observation of upper current, the water during the progress of the depression, a position of vanings for the observation of upper current, the value of which was much dimminded by the precluminant thick-own of the propersion of the pro

evening, which showed that the upper current had changed to south-east. No observations could be made during the two wet days which followed; but early in the morning of the 27th, when the centre was about 100 miles to the north, true cirri were the centre was about 100 miles to the norm, true crit were observed moving slowly from north-east. These soon disap-peared; but at 6 p.m of the same day an important change took place, the bands of ice cloud moving from south-south-west, from which point, or from a little west of it, the belts have continued to travel up to the time of my writing this, the lines being nearly parallel to the isobars, and to the general direction of the surface winds, and precisely resembling in character the stripes depression, whose centre has passed a little to the north of the

observer, has moved away to north-east.¹
(3) In an dishortse paper in the Quant. Journ of the R.
Met. Soc for October 1877, the writer pounted out than in the mount of the part of the state in the upper that in the lower state of the atmosphere in the regions traversed by extra-tropical cyclones. Over a large number of these cyclones, therefore, many of the isobars in the upper regions of the atmosphere do not form closed curves, but upper regions of the atmosphere do not form closed curves, but curves somewhat resembling those which, at the earth's surface, accompanying what are popularly termed V-shaped depressions it is a question of the utmost interest whether, daming the periods in which depressions irrivel to the west, the distribution of gradients in the upper atmosphere is really for the time reversed, and, if so, what can be the causes of so remarkable a change. There is a further question correlated with the above, which deserves more attention than has been given to it. The writer deserves more attention than has been given to it. The writter too gag oppointed out (Joann Scot Met Soc, vol iv pp 333-335) that in cases of depressions travelling wetward across our stands, temperatures at the earth's surface are in general higher of lintances have occurred since 1875 which have confirmed that conclusion. But in most of these cesses an anticipolons has lain to the north seat of us, so that the "gradient force" of the most of the surface of the surf ton addition to the ascensional force, associated with condensa tion in the western segment, due to the indraught of relatively warm air from north and north-east. In the instance described warm air from north and north-east. In the instance descrines in this paper pressure was not particularly high over Scandinavia, during the westward progress of the system, but temperature seems to have been higher, over Sweden at leas', than France.

W. CI FIRM'S LEY May 30.

The Crowing of the Jungle Cock

IN NATURE (vol. xhii p 295) Mi Henry O Forbes has a letter commenting on a statement of Mr Bartlen to the effect letter commensing on a statement of Mr. Barden to the effect that the wild applie cock does not crow, and tearinging that he once heard one. In reply, in the next number of NA1URA, if a concept the control of the control of the control of the All Table 1. If thick that no one who has traveled in the jungle of Barna, during the dry season, can have any doubt that the jungle cock overs, for he cannot fail to have been't them many mer. I had occasion to travel among the hills which form the waterched between the Irawaddy and the Stoting rivers. I non region here a large kind of bamboo was seeding, so that the jungle mabers. I remember one place to particular: the Katen had

numbers. I remember one place in particular . the Karens had prepared us a hut in which to sleep just outside of their village, which consisted, like nearly all the villages in these hills, of a single house, each family having its separate room in the common

"These stopps or currictions are so abundant in the case of most de-pressions, towers the termination of the numerion distributions accompany-ing squalts or thunder showers in Europe and the Northern States that it is augusticly understants that the statement of an English mectorologist, to the augustic production of the statement of the statement of the statement of Ferrel's "Popular Treatise on the Winds" it way into the first edition of Ferrel's "Popular Treatise on the Winds", it to, "Modern Mescoology," p 111

building. "At cock crowing" in the morning we had, close to us, the crowing of the village cocks, and on every side, far and near, the answering crows of multitudes of wild birds. I do no remember ever to have been treated to such a chanticleer concert

The idea that these wild cocks were all hybrids is inadmissible. because (I) they were so very numerous, and (2) the country is very sparsely peopled, the villages all being small and far apart, and the greater part of the country still covered with primæval

The crow of the jungle cock is shrill, like that of the smallest breeds of domestic fowl, and is, perhaps, a little less prolonged than that of the average domestic cock; but it can hardly be distinguished from the crow of a small breed of fowl kept by the Karens, some individuals of which so closely resemble the wild fowl that they are used as decovs.

sows ust they are used as decoys.

I have several times heard wild fowl cackle, and in this poursey, while in the molet of a heavy forest, miles from any human habitation, we came upon a flock of wild fool eacking, and could tell by the tones that both cocks and hens were each long. One of the followers being sent with a gue to it y and get a vitor, some of the briefs was him and flew, whereupon one of the cocking was the peculiar call which the domentic cock gives

when a bird flies over him I might add that, among the numerous birds shot in this region, there was one hen which had a pair of spurs about half an inch long
Rangoon, May 20

Cordylophora lacustris.

It is generally believed that this tube-dwelling Hydrozoa was originally a sait water animal, and although now found a con-siderable distance from tidal water, it still dwells in rivers and canals more or less connected with tidal rivers. I have for many years found it in the Chester and Ellesmere Port Canal. many years tound it in the Chester and Elemere Fort Cana, growing principally on the shell, of the fresh-water mussel, from two to three miles from the tidal river (the Dee). It seems to be a shade-loving animal, at I have always found it under the bridges, and from 4 to 6 feet ben ath the surface of the water.

The tubes only remain during the winter and early spring, and the animal is fully developed in August and September. It is generally accompanied by Fredericella sultana.

THOMAS SHEPHEARD.

Kingsley Lodge, Chester, June 12

Philosophical Instrument Makers,

I FIND in your paper of fune II (p 135) that Messrs. Newton I FIND in your paper of tune it (p. 133) that Messirs. Newton and Co have been appointed philo-ophical instrument makers to the Royal Institution of Great Britain. Allow me to state that they are not the only ones, and that I also was appointed on Jane t by the managers of the Royal Institution of Great Britain to be their philo-ophical instraument maker. I thought that in the interest of the public you should know this fact, A. HILGER.

204 Stanhove Street, Hampstead Road, June 12

The Earthquake of June 7.

THE earthquake of June 7, whose centre seems to have been in the province of Verona, was also perceptible at Basle. The seismonater of the Beroullianum Observatory registered a horizontal shock at 1h 47m 29x. a Basle mean time, which corresponds to the 17m 10x Greenwich mean time.

At Thal, a village east of St. Gall, the hock was strong enough to be felt by several persons
Basic, June 13 A Rig A RICCENBACH-BURCKHARDT

NOTE ON EGYPTIAN IRRIGATION.

N entering upon any account of Egyptian irrigation it is necessary, at first, to point out that it consists of two very broad subdivisions. (1) the irrigation effected by the Nile flood when there is rich muddy water in abundance for a land thrice as big as Egypt, and when everyone considers it his absolute right to have his fields flooded without the expense or trouble of raising the water artificially; and (2) the irrigation effected by the Nile at its lowest, in those hot months of May and June when the water surface is 20 feet below that of the field, and when it is only by the strictest economy that we can water an area not exceeding one-fourth of the whole of

2 The Irrigation of Old Egypt —The first irrigation is the ancient art of Egypt, the culture that, from the days of the Pharaohs, made this little valley the granary of Europe. The products are wheat, baries, beans, maize, and rice. These two last crops require special irrigation. For the gro vith of wheat, barley, and beans, it is enough to saturate the fields, during high flood, from August to October The seed is scattered as the waters retreat, and the fields receive neither irrigation nor rain from that time till the harvest is gathered in at the end of April

3. Perennial Irrigation .- The introduction of the second system is due to the sagacity of Mohamed Ali, who saw that the conditions of soil and climate were such as to favour the growth of cotton and sugar-cane, sub-tropical products greatly exceeding the value of cereals these crops require irrigation during the months when the Nile is at its lowest, hence a system of deep canals was necessary, and it was in trying to carry out this system in Lower Egypt that the Egyptians got into hopeless difficulties, for the canals got blocked with silt, and

it was most difficult to clear them.

152

4 The Barrage unused — The obvious remedy was to raise the water in the river, and divert it into the canals hy a Barrage or dam at the apex of the Delta Such a work was constructed, at a cost of about two millions sterling; but soon after its completion it cracked in a stering; out soon after its confection it cracked in wery alarming way, and, from 1867 to 1883, remained practically useless. The great network of canals continued to be cleared year after year to a depth of about 20 feet below the soil, and for half of each year the corvole

was constantly employed on them.

5 Pumping—The Egyptian Government had abandoned all hope of again using the Barrage. They had entered into a contract with a private company to irrigate Behera by a system of pumps, at an annual cost of from £50,000 to £60,000; and they were about to come to similar arrangements for the rest of the Delta, at an

initial cost of £700,000, and an annual one of £250,000

6 Neglect of Drainage —Continuous irrigation like that of Lower Egypt requires to be accompanied by drainage, otherwise the land becomes soured and waterlogged. No

attention was being paid to this subject in 1883
7. State of Upper Frypt — The first system of irrigation alluded to above continued to be practised in Upper Egypt A few very costly bridges had been built to assist it, but little attention was being bestowed on it, and even in years of average Nile flood we found a loss of annual revenue amounting to about £38,000 taking

8 Addition to Area of Egypt -Such was the state of affairs when we took charge of the irrigation in 1884. am frequently asked whether, since then, there has not been a great addition to the cultivated area of Egypt.

My reply is in the negative.

The question of extending cultivation into the desert is partly one of displacement of population, chiefly one of level, for above the point that the Nile flood can be brought to reach we must not look for an extension of cultivation. Some goes on-notably to the west of the province of Behera and in the Fayoum; but it is not on a very large scale.

o Reclamation of Marshes -An extension much more rapid, and of more importance, is in progress along all the north of the Delta, where land is being yearly reclaimed from marsh and lagoon by our drainage operations.

The cultivated and revenue-paying area of Egypt is about five millions of acres. The lagoons in the north cover an area of about 1,280,000 acres. I expect in a very few years to see at least half of this land reclaimed and cultivated.

10. The Barrage repaired, and the Effect on Lower

10. The Harrage reputred, and the Light of Sept.—What we have done, are dong, and propose to do, then, in future years is as follows:—

First. The Barrage has been completed, and placed in a condition to fulfil its original purpose. From the stream of it are derived three main trunk canals which irrigate the whole Delta, and three smaller canals which irrigate all the country north-east of Cairo and to the south of Zagazig, one of these takes water to Port Said and Suez. The outlay on the Barrage has been, since

1884, about £460,000. Of the three trunk canals, that on the west had been neglected, and completely filled in with sand. It has been restored, and the system of pumps alluded to in paragraph 5 will, I hope, never be used again,

The canal supplying the East Delta (termed the Tewfikieh Canal) has been entirely made since 1886, at a cost

of £372,000

Practically, the whole summer supply of the Nile is diverted by the Barrage into these canals, and none flows The value of the work is thisout useless to the sea that so long as there is water in the Nile it is under our control, and, however low the river may fall, the water will get on to the fields, and the great cotton crop will be secured In former days, during low Nile, the canals were left high and dry, and what water there was flowed out to the sea, useless.

The Barrage has not much increased the area of cultivation, but it has very largely increased that of land bearing double crops—that is, the area producing cotton bearing double crops—that is, the area producing conton It was in 1884 that, by employing temporary measures, we began to use the Barrage—Since then, the average annual yield of cotton has been 333,893 kantars (12,000 tons) greater than in the five years preceding 1884.—This tons) greater than in the five years preceding 1884. represents a value to the country of £835,000 a year, exclusive of the value of cotton-seeds

11 Provision for Navigation - Secondly As the abstraction of water renders impossible the river navigation straction of water renders impossible the river having and durling four or five months every year, two main canals have been selected, one of them roughly parallel to each of the branches of the Nile, and fitted with locks and rendered navigable. This is not yet quite finished. When it is, it will enable laden boats to pass freely be tween Cairo and Alexandria on one side, and Cairo and Damietta on the other side, at all seasons of the year Other locks have been built, and obstructions removed, so that navigation has had an impulse given to it throughout the whole Delta.

12 Drainage Introduced .- Thirdly. Year by year have been opened out new miles of drainage arteries, and in Behera, Gharbieh, Dakahlieh, Sharkieh in Lower Egypt, and in the Fayoum, large tracts have been reclaim from salt-marsh, and now yield good crops. The Budget for the current year contains £140,000 for new drainageworks in Lower Egypt No part of our work has been more appreciated than this, but, unfortunately, the defective system of revenue statistics makes it impossible to say what lands have been reclaimed. The mileage of drains is not less than 1500

13 Measures for Improving Irrigation of Upper Egypt — Fourthly. 1 have said, in paragraph 7, that there has been an annual loss of about 438,000 in average there has been an annual 1050 rabout 3.50.00 inaverage years, due to the Nile flood not attaining all the fields of Upper Egypt In exceptional years this loss has been much greater. Thus, after the very deficient flood of 1877 it amounted to £1,111,880. After 1888 it was about £300,000. If such was the loss of revenue alone, it may ue imagined what a heavy calamity was inflicted on the

cultivators. Colonel Ross, Inspector-General of Irrigathese deficient years there was water enough in the river that, by a judicious system of canals, sluices, siphons, escapes, weirs, &c, it may be arranged that, even in the worst years, the whole Nile valley shall receive its share of mud-charged water

This involves the construction of no great work like the Barrage (the most expensive does not exceed £45,000), but of a great number of works costing from £5000 to £15,000 each, requiring very careful designing, and built often in remote spots, where construction of any kind is difficult.

construction of any sind is diment.
These works have been going on now for more than a vear. When finished, as I hope they will be in 1893, the whole outlay will be about £600,000. And then, I crust, the lands of Upper Egypt will yield their full crop, however defective may be the Nike Bood
14. Agricultural Koad—Fifthly. A minor subject,

and yet one of great value to the country, deserves notice here—namely, the introduction of agricultural roads, This reform is due to Riaz Pasha Until two years ago at would have been impossible to take a cart-load of agricultural produce from any one centre of population to another in the Delta. Comparatively few of the canals were adapted for boats, and the one means of transporting cotton to the railway stations or to the river was by ing cotton to the railway stations or to the river way camels, which, however well adapted for carrying burdens on the firm sand of the desert, are not suitable for the rich alluvial soil and the sloppy fields of the Nile valley This is all being changed. The people have willingly accepted a tax never exceeding P.E. 4 or 5 per feddan for one year only, and, with the fund thus raised, a whole network of serviceable roads is being formed sufficiently adapted for this dry climate

15. Corvée Abolition - The above paragraphs describe generally the improvements that have been brought about in the last seven years Second to none is the boon that has been conferred on Egypt in the abolition of the in the clearance and repairs of canals and embankments was effected by the forced, unpaid, unfed labour of the peasantry. In 1884 this labour amounted to 85,000 men working for 160 days. We were told that this was quite a necessary state of things, that it would be impossible to maintain the irrigation-works otherwise, and that the Egyptian peasant, unlike that of any other country, would not work for wages, and must be forced We estimated that to redeem this corvée and to pay for all this labour would cost £400,000 Nubar Pasha, in the face of the greatest financial difficulty and opposition, managed to give an annual grant of £250,000 for this object. Riaz Pasha, at the end of 1889, found means of granting the remaining £150,000, and in 1890, for the first time per-haps in all history, there was no corvée in Egypt

16. Canal Legislation - When we began work here, we were much hampered by the want of any canal legisfation, there being no law corresponding to what is found in India, Italy, and elsewhere, treating of the many con-flicting questions connected with irrigation. After three years' discussion, a very useful Canal Act now exists, and the only misfortune is that it is not binding on residents

of foreign nationality.

17 Storage of Nile Water - Lastly, as regards our programme for the future, there is abundance to do in carrying out, year by year, solid unpretending reforms; but, besides these, a very large question is coming to the front. The restoration of the Barrage placed at our disposal all the water of low Nile, but the increase in the area irrigated outruns the increase in the water available, and we have to look for means of storing the surplus volume of the flood, and utilizing it when the river is low.

There are two ways in which this may probably be done. The first, which is connected with the name of an

ingenious American gentleman, Mr. Cope Whitehouse, is to divert a portion of the flood into a great natural depression existing west of the Nile valley, and there to form a storage reservoir, to be drawn upon as the water in the river decreases. This has been examined and found feasible, but the expense, probably 18 millions sterling, is against it The alternative project is to pond up water in the valley of the river itself above Assouan This project is being studied at present There can be hardly any further extension of the cotton cultivation if one or the other of these schemes is not executed. There

is room enough in the country to employ both.

COLIN SCOTI MONCRIEFF,

Under-Secretary of State, Public Works Department

Cairo, March 5, 1891.

THE SECOND ORNITHOLOGICAL CONGRESS.

A FULL report of the proceedings of this important Congress can only be obtained when the official Comptes rendus are published, for the officers of one section were unable to attend the meetings of the other sections owing to the fact that all four sections sat at one and the same time. This is the only complaint we have to make concerning the recent proceedings, but as it affects the future of these useful reumons, we feel compelled to make our protest, because, by the simultaneous session of all the sections of a Congress, no man, however interested in the subjects under discussion, can hear all that he wishes to hear, the visitor has to choose between two meetings, both of which probably possess for him an equal interest It must be obvious to everyone who had the privilege of attending the second Ornithological Congress that a great gathering of specialists such as that which took place last month must require more time than three days to discuss such varied problems as were placed

The city of Budapest was happily chosen as the meeting-place of the Congress, and it may well be questioned whether there is any country in the world that could have offered so many attractions to the ornithologist as Hungary The hospitality of the Hungarians is proverbial, the accommodation in the beautiful capital is unlimited, and access thereto is easy. After an enjoyable trip down the Danube from Vienna, the travellers found themselves at the opening conversations of the Congress, which was celebrated in the Grand Hotel "Hungaria." Here the Hungarian Committee had assembled with all the members of the Congress to welcome the guests, and the inaugural banquet served as a pleasant medium for the introduction of the strangers On May 17 the first general meeting of the Congress took place in the sumptuous theatre of the Hungarian National Museum After some words of welcome from the Burgomaster of Budapest, the officers for the Congress were chosen as follows:—Honorary Presidents Count Bethlen, Minister of Agriculture; Count A. Csáky, Minister of Public In-struction; Mr B Kállay, Minister of Finance Presidents Prof. Victor Fatio (Geneva) and Mr. Otto Herman, M.P. Vice-Presidents: Dr Rudolph Blasius (Brunswick), Prof. S Brusina (Agram), Prof. R Collett (Christiania), Mr. J S Brusina (Agram), Prot. A Conett (Streen), Major de Csató (Budapest), Dr. Otto Finsch (Bremen), Major (Bremen Alex von Honieger (Greifswald), Dr A B. Meyer (Dresden), Dr. E. von Middendorf (Livonia), Dr. Enst Oustalet (Paris), Dr. Bowdler Sharpe (British Museum), Mr. E von Szalay (Budapest), Victor Ritter Tschusi von Mr. E. Von Szaiay, (totagest), victor atter Isanisi von Schmidhoffen (Hallein). General Secretary Dr. G. von Horvath. Secretaries: Mr. E. Chernel von Chemel-haza, Dr. A. Lendl, Dr. L. Lorenz von Liburnau, Dr. A. Lovassy, Dr. J. von Madarása, Mr. O. Reiser, Prof. G. Szikla. Hon Secretaries: Mr. E. de Gadl, Mr. Prof. G Szikia. Hon Secretaries: Mr. E. de Gaal, Mr. B. de Lipthay, Mr. J. d'Ottlik. Quæstor. Mr. J. von

Xántus. After preliminary reports, Major Alex. von Homever gave his reminiscences of travel in West Africa. some years ago, and his imitations of the notes of African birds were strikingly rendered. Four different sections of the Congress were appointed, the names of the different delegates from foreign countries were read out, as well as letters of apology for their absence from several naturalists. Prof. Furbringer, Baron de Selys Longchamps, and others.

The officers of the different sections were constituted as The officers of the different sections were constituted as follows:—(1) Systematic Section, Presidents, Dr. Bowdler Sharpe (London) and Prof Class (Petinna); Vice-Presidents, Dr. A Rechemow (Erdina) and Mr. C. Danfordon, Dr. A Rechemow (Erdina) and Mr. C. Danfordon, Dr. Alberton, D

a view not to be surpassed in beauty and interest in any

a view not to be surpassed in beauty and interest in any country.

On Monday, May 18, the Systematic Section met in the lecture-theatre of the Polytechnicum, which was placed at the disposal of the Congress by Prof. Stabo, whose work is well known and appreciated in Grest Britain. Papers were read by Prof. Klug, on some points in the announy of the stomach in brids, and by Dr. Bowdler Sharpe on the classification of birds. by Dr. Bowdler Sharpe on the classification of birds, the latter lecture being illustrated by several large diagrams and a wax model of the phylogenetic tree, in which Prof. Furbringer traces the evolution of birds from a reptilian stock. The remainder of the work of the systematic Section consisted in the passing of the rules of nomenclature, as put forward by a committee consist-ing of Prof. Mobius, Dr. A. Reichenow, Count von Berle-poch, Dr. A. B. Meyer, and Dr. W. Blasius. The recommendations of this committee were adopted, almost in their entirety by the meeting, after a two-days' discussion, notwithstanding some protests of Dr Sharpe, and Mr. Buttikofer of the Royal Museum of Leyden, who found themselves in a hopeless minority. The chief points carried were: the adoption of the 10th instead of the 12th edition of the "Systema Nature" of Linneus, the recognition of trinomial names in certain cases, and the adoption of names, even faulty in construction or misspelt, with all the consequences The tone of the report, however, is so moderate, and exhibits so much consideration for the methods of other ornithologists, that it ought to be possible now to arrive at a definite conclusion for European usage at least, and then it would be easy to assimilate the American and European methods of nomenclature.

In the afternoon of the 18th, the Congress met in the Museum, and Dr Otto Herman, M P., gave an account of the distribution of birds in Hungary, and explained the collections which had been made specially for the Congress These consisted of beautifully mounted cases of Hungarian birds with nests and natural surroundings. some very rare species were included in the collection, which was the work of four ornithologists-Dr O Herman, which was the work of four ornithologists—LT O TERMEN, M P, DT Julius von Madarást, Mr. Chernel, and Prof Szikia. These gentlemen had each occupied a station in different parts of Hungary, and had not only collected the series of biids exhibited, but had also made exact the series of builds exhibited, but had also made exact observations on migration and distribution. The Hungarian National Museum is a very fine building, and contains a collection which fairly surprised most of the visitors, the series of native birds being especially complete. Large groups of Laemmergeners, Sea Eagles, Ospiery, &c., with their nests, eggs, and young birds, are to be seen in the Bird-galleries, and these are principally the work of a well-known Hungarian ornithologist, Dr J von Madarász. The collection of Mammalia also com-

prises some great rarntes, and the whole Museum teems with specimens procured by the veteran explorer, Mr. J. von Xántus, whose labours in Lower California and Central America, as well as in Borneo and the Sunda Islands, are also widely known. The Museum likewise contains a fine series of insects, especially likewise contains a nne series of insects, especiasing Coleoptera, which were shown with much natural pride by Dr. Frivaldsky, who is responsible for the leautiful arrangement of the latter groups. The afternoon closed with an adjournment to the Hungarian Academy of Sciences, where Prof. Robert Collett read a paper on Arctic Bird-life before a crowded audience, and the evening concluded with a banquet at the "Archiduc Stephan" Hotel.

On Tuesday the debate on nomenclature was continued; and in the afternoon the Congress assembled on St. Margaret's Island, which forms a most delightful summer retreat for the inhabitants of Budapest, with its dozens of nightingales, its ruined cloisters, and its sulpbur

On Wednesday, the 20th, the general meeting of the Congress was held to receive the reports of the different sections and committees, and the business was concluded. A farewell banquet took place in the evening, and the second Ornithological Congress came to an end

Next day the members were scattered in different directions—some to their homes, some to join one of the pre-arranged excursions. These were three in number— one to the Hanság marshes and Ferto, a second to the Platten-See, and a third to the districts of the Drave. Of the first excursion, in which the writer took part, he can only say that, under the direction of Dr von Madarász, the members of the Congress who accompanied it underwent a never-to-be-forgotten experience The species of birds observed were mostly those unknown to an English naturalist, and the hospitality dispensed by Prince Esterhary, Baron von Berg, and Count Széchenyi, is not likely to disappear from the memory of those who had the good fortune to partake of it.

THE IMPERIAL PHYSICAL AND TECHNICAL
INSTITUTION AT BERLIN.

THE Imperial Physical and Technical Institution which was founded in 1887 at Charlottenburg, near Berlin, under the auspices of the German Government, has now been for some time in active operation, and recently there has been issued by the executive Director. Dr. L. Loewenherr, a Report on the work of the Institution up to the end of last year.

It may be remembered that the Institution has two main objects in view. first, that of physical and technical research appropriate to the practical development of manufacture-researches for instance as to the qualities of metals and materials and as to methods of construction and measurement; the second object being that of fundamental research in theoretical problems in physics, and the testing of all kinds of measuring apparatus applicable for use in science, art, and manufacture. It appears to undertake, therefore, investigations and verifications similar to those undertaken in this country by the Board of Trade, or at the Kew Observatory . and, in France, by the Bureau International des Poids et Mesures. Its staff includes (exclusive of the clerical staff) a President, nominated by the Reichstag, a Director, with a Committee of seven members; seven scientific officers in the department of research; four technical assistants, and several mechanics and machinists

From time to time, as new methods of testing are adopted, or as fresh work is undertaken, explanatory papers are issued by the responsible officers of the Instimeteorological measurements; Dr. K. Feussner and Dr St. Lindeck, on electrical measurements; Dr. O. Lummer and Dr. E. Brodhun, on optical measurements, including photometry; Dr. F. Foerster and Dr. F. Milius, on chemical analysis of glass.

We gather from the Director's Report above referred to, that the Institution has provided itself with funda-mental standards of length and mass: with primary thermometers and barometers; with electrical standards of resistance, current, and pressure; and with apparatus for testing the flashing point of petroleum and inflammable liquids. Its metrological work for the public has included the proving of clinical thermometers, pyrometers, aneroid barometers, manometers, alcohol thermometers for low temperature, and thermometers for chemical research.

In October 1888, the official testing of thermometers was transferred from the Normal Alchungs Commission at Berlin to the Imperial Institution, and all thermometers are still tested on the basis of the regulations laid down by the Commission on November 10, 1885; excepting that, in place of basing the errors of scientific thermometers on a mercurial thermometer, thermometer readings

are now reduced to the more accurate scale of the airthermometer or hydrogen-thermometer.

The use of thermometers for determining pressures, or altitudes, &c., on the occasion of journeys of exploration, &c., seems of late to have increased, for many such have act, seems of rate to nave increased, for many such have been already presented for examination at the Institu-tion If the thermometers are made of Jena glass (or of other hard thermometer glass), it would appear to be possible to ascertain pressures with but little trouble to ± 0.23 millimetre The necessity for using proper glass is shown in an experiment carried out at the Institution with two thermometers, Nos. 42 and 43, made of ordinary Thuringian and crystal glass. On September 7, 1888, the corrections of these thermometers at 87° C. were found to be-

The thermometers were then heated for 15 minutes to a temperature of 100° C; they were then allowed to cool, and subsequently retested on September 10, when their errors were found to be-

Such variation in the reading of a thermometer after its exposure to a high temperature would unfit it for use in the exact determination of pressures or altitudes

With reference to the testing of various sorts of glass Dr. F. Milius points out that Weber's process, generally made use of, and which consists in exposing the body to be examined to an atmosphere of muriatic acid vapour for a space of twenty-four hours, is not always trustworthy Thus, according to the quality of the glass, it appears to be covered more or less, after exposure to the acid vapour, by a thick rime (or hoar frost), and that although the exa thick rime (or noar trost), and that although the ex-perienced observer finds Weber's method tolerably certain, yet the less experienced observer may sometimes be left in doubt, particularly where rough surfaces are treated, as to whether the rime exists or not, Dr. Milius therefore proposes an optical form of test other than that of the muriatic acid test, as is explained at length in his paper.

Dr Milius, in conjunction with Dr F. Foerster, has also

Dr. Millius, in conjunction with Dr. F. Foerster, nas also investigated the solubility, in water, of potash and soda glass, particularly with reference to Schott's experiments as to the capacity of potash water-glass for absorbing water without losing its vitreous quality. This latter fact can be ascertained by keeping pulveraced water-glass under water, when, as in the case of hydraulic cement, a hardening of the paste begins to take place. This pro-cess is connected with a development of heat; in the case of water-glass in which there was one atom of po'ash to three of silicic acid it was obseved at the Institution | valuable support from the State.

that within a quarter of an hour the moistened matter had been heated 10° Centigrade, and it became hard in one day; if the proportion of silicic acid is larger, the glass requires from two to three days for solidification. Their researches appear to show that for purposes con-nected with mercurial electrical standards, the glass used should be very little soluble in water and acids; hard glass, for instance, which had a base of soda, and not potash, being little hygrometric

In the important field of electrical measurements, the

Institution appears also to be doing good work. It is preparing to undertake the verification of all kinds of apparatus; including voltmeters, ammeters, meters for the measurement of power and efficiency, galvanometers,

and resistance coils.

In the field of practical photometry we have to com-pare the intensities of different sources of light as experienced by the eye, but unfortunately we have not, even for commercial purposes, any satisfactory method by which intercomparisons may be made between the relative intensities of coal-gas, electric and oil lights respectively. In practical photometry much is being done in this country by Abney, Vernon-Harcourt, Chaney, and others, as well as by Lummer, Brodhun, and others in Germany, but as yet no standard photometer has been produced. The standard light is still also the ancient "sperm-candle," and the method of comparison is still the old-fashioned "grease-spot" Bunsen photometer more or less modified. The German authorities appear to be fully alive to the necessity of improvement in this field of technical research; and have investigated M Violle's incandescent platinum-standard of light, and also the Hefner lamp and Aubert's apparatus; and for electrical light purposes they have followed a form of standard glow lamp.

Among the papers above referred to, we notice also one by Dr. Loewenherz, on the testing of tuning-forks. The Institution undertakes the testing of tuning-forks, on payment of a small fee, the object of the examination being to of a small ree, the object of the examination being to ascertain the correctness of the height of the tone of the fork in terms of an international diapason; or the number of the vibrations of the fork per second, at the temperature of 15° Centigrade, the pitch of the note A being fixed at 435 entire vibrations per second, or 870 half or single vibrations according to the French method of counting Tuning-forks sent to the Institution for examination are required to be constructed in accordance with conditions laid down by the Institution Unity of pitch is of fundamental importance in music and in the construction of musical instruments, and it is to be desired that some authoritative testing of tuning-forks might be similarly undertaken in this countr

In metallurgy the work of the chemical laboratories of the Institution does not appear to be extensive; it has included more particularly analyses of the metals platinum, cadmium, and rhodium. In the Physical Laboratory, measuring instruments of precision for workshop use, such as speed and power indicators, screw-thread gauges, have also been examined by the Institution; and its geodetical work has included the verification of instrurements of precision for General Schreiber, of the Imperial Prussian Land Survey. The department has undertaken also the verification of polariscopes, lenses, prisms, and other optical instruments, to a limited extent.

The above observations may serve to show that the Institution is alike prepared to verify a standard—as a measurer of electrical resistance—with the utmost accureconstruct of creatment resistance—with the utmost accuracy, or to test an instrument for common purposes—as a gas meter. How far the Institution may be self-supporting is not stated in the Director's Report; but as the demands for verification work of this kind are largely voluntary, it would appear to be evident that the excellent staff of the Institution could not be maintained unless it received

CRYSTALLIZATION.

THERE is something very factinating about crystalls. It is not merely the intrinsic beauty of their forms, sheir picturesque grouping, and the play of light upon their faces, which there is a feeling of wonder at the power of Naura, which causes substainces, in passing from the by plane faces, each substaince with its own set of forms, and its faces airranged with characteristic symmetry; some, like alien, in perfect ottabedra; others, his blue vitriol, in shapes which are regularly oblique. It is this content of the state of the st

We know that the external forms of crystals are instructed with their internal structure. This is betrayed by the cleavages with which in mice and selenite the properties of the properties and selenite departs are in season to the properties, and properties, and properties, and properties, and properties, and properties, and properties, angle and double refraction, and the effects of crystal on polaracel light. These familiar facts lead up to the thought that it is really the internal structure does not be the properties of the

Dallon fancied be had proved that the atoms of the chemical elements must be spherical, because there was no assignable cause why they should be longer in one assignable cause why they should be longer in one lasen no reason why the excursions of the parts of a molecule from the centre of mass should be equal in all mections, and therefore assume, as the most general case, that these excursions are unequal in different directions. And, since the movements must be symmetrical with the former of the centre of the cen

Here I may, perhaps, guard against a misconception. We chemists are familiar with the notion of complex molecules; and most of us figure to ourselves a molecule of common salt as consisting of an atom of sodium and one of chlorine held together by some sort of force, and it may be imagrined that these atoms are the parts.

the molecules which I have in mind. That, however, is not my notion. I am paradoxical enough to disbelieve altogether in the existence of either sodium or chloring in common salt. Were my audience a less philosophical one I could imagine I heard the retort from many a lip: "Why, you can get sodium and chlorine out of it, and you can make it out of sodium and chlorine !" But no. you cannot get either sodium or chlorine out of common salt without first adding something which seems to me of the essence of the matter. You can get neither sodium nor chlorine from it without adding energy; nor can you make it out of these elements without subtracting energy.

My point is that energy is of the essence of the molecule.

Each kind of molecule has its own motion; and in this I think most physicists will agree with me. Chemists will agree with me in thinking that all the molecules of the same element, or compound, are alike in mass, and in the space they occupy at a given temperature and pressure. The only remaining assumption I make is that the form of the ellipsoid—the relative lengths of its axes-is on the average the same for all the molecules of the same substance. This implies that the distances of the excursions of the parts of the molecule depend on its constitution, and are, on the average, the same in stances.

I have come to the end of my postulates. I hope they are such as you will readily concide. I want you to conceve of each molecule as having its parts in extremely rapid wibration, so that it occupies a larger space than it would occupy if its parts were at rest; and that the excursions of the parts about the centre of mass are on the average, at a given temperature and pressure, compared within a certain ellipsoid, that the dimensions of the control of

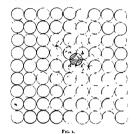
We have now to consider how these molecules will pack themselves on passing from the fluid state, in which they can and do move about amongst themselves, into the sold state, in which they have no sensible freedom. If they attract one another, according to any law, and for my purpose gravily will swifflice, then the laws of energy of the system shall be a minimum. This is the same, in the case we are considering, as saying that the molecules shall be packed in such a way that the distances between their centres of mass shall on the whole be the least possible, or, that as many of them as possible shall be packed into such a saying that the map the packed most in space. In order to see how this packing particular case in which the axes of the ellipsoids are all equal—that is, when the ellipsoids happen to be spheres. The problem is then reduced to finding how to pack the greatest number of equal spherical halls into a given space. It is easy to reduce this to the problem of finding how the spheres can be arranged so that each one shall show the spheres can be arranged so that each one shall the connered spaces between the balls, the unoccupied to the state of the state o

in the first place we may start with a square of halls, as in Fig. 1, where each is touched by four others. We may then place another (shaded in the figure) as as to touch the start of th

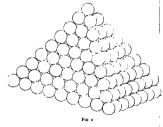
NO. 1129, VOL. 441

A Discourse delivered at the Royal Institution of Great Britain on Edday, May 15, 1891, by G. D. Lavetog, F. R. S.

Again, if we start with such a triangle, as in Fig 3, where each ball is touched by six others, we can place one ball —the shaded one—so as to rest on three others, and can then place six more round it and touching it, as in-dicated by the dotted circles In three of the triangular holes between the shaded ball and the dotted balls touching it we can place three more, so as to touch the shaded ball-again twelve touching it in all. If we complete



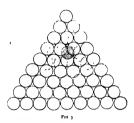
the pile, we shall get the triangular pyramid represented by Fig. 4, where each of the three sides is a right-angled triangle, while the base is an equilateral triangle. It will be seen that in the faces of this pyramid each ball (except those outside) is touched by four others. In fact, the arrangement in these faces is the same as in the base of the former pyramid; and the two arrangements are really identical in the interior, only one has to be



turned over in order to bring it into parallelism with the other. Fig. 2 represents half a regular octahedron, Fig 4 the corner of a cube Ellipsoids, if they are all equal and similar to one another, can be packed in precisely the same way, so that each is touched by twelve cisely the same way, so that each is touched by weive others, provided their axes are kept parallel to each other— that is, if they are all oriented alike. This, then, by the laws of energy, will be the arrangement which the mole-NO. 1129, VOL. 44]

cules will assume, in consequence of mutual attraction, in passing from a fluid to a solid state.

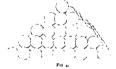
Next, let us see how the packing of the molecules will affect the external form. And here I bring in the surfacension. We are familiar with the effects of this force in the case of liquids, and if we adopt the usually received theory of it, we must have a surface-tension at the boundary of a solid, as well as at the surface of a liquid. I know of no actual measures of the surface-tension of solids, but Quincke has given us the surface-tensions of a number of substances at temperatures near their



points of solidification, in dynes per lineal centimetre, as-

Platinum Gold Zine Tin Mercury Lead , Silver Bismuth Potassium Sodium	· ·	 : :	983	Sulphur Phosphorus Wax	onate .	244 212 206 114 86·2 70 4 41·3 41 1 33 4

The surface-tensions of most of the solids are probably greater than these, for the surface-tension generally



diminishes with increase of temperature; and you see that they amount to very considerable forces. We have to do, then, with an agency which we cannot neglect. In all these cases the tension measured is at a surface bounded by air, and is such as tends to contract the surface. have, then, at the boundary between a crystallizing solid and the fluid, be it gas or liquid, out of which it is solidifying, a certain amount of potential energy, and by the laws of energy the condition of equilibrium is, that this notential energy shall be a minimum. The accepted potential energy shall be a minimum. theory of surface-tension is that it arises from the mutual

attraction of the molecules. The energy will therefore be a minimum for a surface in which the molecules are as closely set as possible.

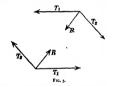
Now, if you draw a surface through a heap of balls packed so that each is touched by twelve others, you will find that the surfaces which have the greatest number of centres of balls per unit area are all plane surfaces. That in which the concentration is greatest is the surface of a regular ortachedron, next comes that of a cube, then that of a rhombic dodecahedron, and so naccording to the law of indices of crystallographers.

The relative numerical values of these concentrations are as follows, taking that of the faces of the cube as unity:—

Octahedron 1°1547 | Tetrakishexahedron 0°4472 Cabe 1°0000 | Eikositessarshedron 0°4083 Dodecshedron ... 0°7071 | Triakisoctahedron 0°3333

We do not know that the surface-tension is exactly in the inverse proportion to the concentration, all that we can at present say is that it increases as the concentration diminishes.

If then, the molecules occupy spherical spaces, the bounding surface will end to be a regular octahedron. But we have another point to consider. If a sold is bounded by plane surfaces, there must be edges where these planes meet. At such an edge the surface-tensions will have a resultant (see Fig. 2) tending to compress the mass, which must be met by a corresponding opposite mass, which must be met by a corresponding opposite must be a corresponding resultant of the tensions on the opposite side of the crystal. Hence, if one face of a form



is developed the opposite face will also be developed, and generally, if one face of a form be developed all the faces will be developed; and if one edge, or angle, be truncated. But the cross-gooding edges, or angles, will be truncated. Were it otherwise, there would not be a balance between the surface-transons in the several faces. But there is another point to be taken into account. The surface the tension per unit surface, or by reducing the total surface. When a liquid separates from another fluid, as another fluid, as the control of the form a solution of chloral hydrate on adding an alkalı, or a cloud from most air, the liquid assumes the form which, for a given mass, has the least surface—that is, the drops are spherical. If you cut of the procube or an octahedron, you bring it nearer to a sphere, and if you suppose the volume to remain constant, you soll diminish the surface. And if the diminishment of the total surface is not compensated by the increased energy on the truncations, there will be a tendency for the crystals to grow with such truncations. The like will be carried and the control of the provided the surface energy of the new faces is not to great as compared with that of the first simple form.

But it does not always happen that an octahedron of

NO. 1129, VOL. 44]

alum develops truncated angles. This leads to another point. To produce a surface in a continuous mass requires a supply of energy, and to generate a surface in the interior of any fluid is not easy. Air may be supersaturated with aqueous vapour, or a solution with a salt, and no cloud or crystals be formed, unless there is some discontinuity in the mass, specks of dust, or something of the kind. In like manner, if we have a surface already, as when a supersaturated solution meets the air or the sides of the vessel containing it, and if the energy of either of these surfaces is less than that of a crystal of the salt, some energy will have to be supplied in order to produce the new surface, but not so much as if there were no surface there to begin with. Hence, crystals usually form on the sides of the vessel or at the top of the When a solid separates from a solution there is generally some energy available from the change of state, hich supplies the energy for the new surface. But at which supplies the energy for the new surface. But at first when the mass deposited is very small the energy available will be correspondingly small, and since the mass varies as the cube of the diameter of the solid, whereas the surface varies as the square of the diameter the first separated mass is liable to be squeezed into liquid again by its own surface-tension. This explains the usual phenomena of supersaturated solutions. A deposit occurs partition of supersaturated solutions. A deposit occurs most easily on a surface of the same energy as that of the deposit, because the additional energy required is only for the increased extent of surface. It explains, too, the tendency of large crystals to grow more rapidly than small ones, because the ratio of the increase of surface. to that of volume diminishes as the crystal grows.

While speaking of the difficulty of creating a new sur-

face in the interior of a mass, the question of cleavage suggests itself. In dividing a crystal we create two new surfaces—one on each piece, and each with its own energy The division must therefore take place most readily when that surface energy is a minimum. the principal cleavage of a crystal made up of molethe principal cleavage of a ciystal made up of mole-cules having their motions comprised within spherical spaces will be octabedral. As a fact, we find that the spaces will be octabedral has a fact, we find that the fedral, or regular system, have octabedral cleavage. But not all; there are some, like rock salt and galena, which cleave into cubes, and a very few, like blendt, have their easiest cleavage dodecahedral. These I have to stances—as, for misance-funct-absences—which haves a series. stances-as, for instance, fluor-spar-which have a very distinct octahedral cleavage are rarely met with in the form of octahedra, but usually in cubes. In regard to this, we must remember that the surface energy depends upon the nature of both the substances in contact at the surface, as well as on their electrical condition, their tem-perature, and other circumstances. The closeness of the molecules in the surface of the solid determines the energy, so far as the solid alone is concerned; but that is not the only, though it may be the most important factor conducing to the result. It is therefore quite possible that, under the circumstances in which the natural sable that, under the circumstances in which the manufacture crystals of flour were formed, the surface energy of the cubical faces was less than that of the octabedral, although when we experiment on them in the art it is the other way. This supposition is confirmed by the well-known fact that the form assumed by many salts in crystallizing is affected by the character of the solution. crystallining is anected by the character of the solution. Thus alum, which from a solution in pure water always assumes the octahedral form, takes the cubic form when the solution has been neutralized with potash. To return to the cubic and dodecabedral cleavages. If we suppose the excursions of the parts of the molecule

To return to the cubic and dodecabedral cleavages. If we suppose the excursions of the parts of the molecule to be greater in one direction than in the others, the figure within which the molecule is comprised will be a prolate spheroid; if less, an oblate spheroid. Now, as already explained, the spheroids will be packed as closely as possible if the saxes are all parallel and each is touched

by twelve others. Now suppose the spheroids arranged sin Fig. 6, with their axes perpendicular to the plane of the figure, place the next layer in the black triangular spaces, and complete the pyramid. The three faces of complete the pyramid. The three faces of the properties of the place of th

Again, if the spheroids have their axes and greatest diameters in the ratio of $i \cdot \sqrt{\lambda}$, and we place four, as in Fig. 7, with their axes perpendicular to the plane of the figure, then place one upon them in the middle, and then four more upon it, in positions corresponding to those of the first four, we get a cubical arrangement, the centre of



a spheroid in each angle of a cube, and one in the centre of the cube. Crystals so formed will have cube symmetry, but the concentration of molecules will be greatest in the faces of the dodecahedron, and their easiest cleavage will be, like that of blende, dodecahedral.

If spheroids of any other dimensions be arranged, as in Figs. 1 and 2, with their areas perpendicular to the plane of Fig. 7, we shall get a crystal with the symmetry of the pyramidal system. If the spheroids be prolate, the fundamental octahedron will be elongated in the direction of the axis, and if sufficiently elongated, the greatest condensation will be in planes perpendicular to the axis, and the easiest cleavage, as in prussate of potash, in those planes. On the other hand, if the spheroids be sufficiently oblate, the easiest cleavage will spheroid be sufficiently oblate, the easiest cleavage will

be parallel to the axis.

If spheroids be arranged, as in Fig. 6, with their axes



perpendicular to the plane of the figure, they will, in general, produce rhombohedral symmetry, with the rhombs acute or obtuse, according to the length or shortness of the assess of the spheroids. The cubical form the control of t

occupy either the three adjacent white triangles or the three black ones. Either position is equally probable three black ones. The layer occupying the white triangles is in the position of a twin to that occupying the black triangles So far as the central parts of the layer are concerned, it will make no difference in which of these ways the molecules are packed. It is only at the edges that the surface-tension will be affected. If the form growing be a rhombohedron, a succession of alternating twins will produce a series of alternating ridges and furrows in the rhombohedral faces, which will give rise to increased surface-tension, which will tend to prevent the twinning On the other hand, an hexagonal form and its twin, formed in the way indicated, are identical, and we have in this fact a cause tending to the production of hexagonal forms This tendency is increased by the fact that, for a given volume, the total surface of the hexagonal forms is in general less than that of the rhombohedral Indeed, such forms lend themselves to the formation of almost globular crystals, as is well seen in pyromorphite and mimetite.

I 5Q

If the spheroids be arranged with their axes in other postions than those we have been discussing, or if the molecules occupy ellipsoidal spaces, they will, when packed so that each is touched by twelve others, give figures of less symmetry. The results may be worked out on the lines indicated in the foregoing discussion, and will be found to correspond throughout to the observed facts.

Bravais long ago proposed various arrangements of molecules to account for captaline forms, and Sohncke has extended them to further degrees of complication in order to account for additional facts in crystallography. But neither of them has given any reason why the molecules should assume such arrangement. To me to the control of the

We are now in a position to understand the interesting facts brought forward by Prof. Judd in a discourse delivered at the Royal Institution early this year However long a crystal has been out of the solution, or vapour, from which it was formed, it's surface-tension will remain unaltered, and when it is replaced it will grow exactly as if it had not been removed. Also, if any part be broken off it, the tension of the broken surface will, if it be not a cleavage face, be greater than on a face of the crystal, and in growing, the laws of energy necessarily cause it to grow in such a way as to reduce the potential energy that is, to replace the broken surface by the regular planes of less surface energy. The formation of "negative crystals" by fusing a portion in the interior of a crystalline mass, is due to the same principle. Surfaces of least energy will be most easily produced inside as well as outside, and in a crystalline mass of course they will be parallel to the external faces of the crystal. We see the same thing in the action of solvents. Most metals assume a crystalline texture on cooling from fusion, and when slowly acted on by dilute acids the surfaces of greater energy are most easily attacked, in accordance with the laws of energy, and the undissolved metal is left with same of clergy, and the unorsoived metal is left with surfaces of least energy which are the faces of crystals. This is easily seen on treating a piece of the plate, or of galvanized ron, with very dilute aqua regia. In fact, solution is closely connected with surface energy It is probably the low surface energy of one form of crystals of sulphur which makes them insoluble in carbon

disulphide, and this low surface energy may be an electrical effect.

I pointed out that the development of all the faces of a form, and the similar modification of all corresponding edges and angles of a crystal, is in general necessary in order to produce equilibrium under the surface-tensions. But we sometimes find crystals with only half the modifi-cations required for symmetry. In such cases the surfacedeform the molecules. When the crystal was growing, there must have been equilibrium, and therefore a pressure equal and opposite to this effect of the surfacesuppose that such a force would arise. The electric field might give rise to a stress in opposition to the aggregation of the molecules in the closest possible way, and then the crystal would grow such faces as would produce an equal and opposite stress Inequalities of temperature, or the presence of molecules of other kinds amongst those of the crystal, might produce similar results When the stress due to electricity, or to temperature, was removed by change of circumstances, that due to the surface-tensions would persist, and the crystal would be left with an internal strain. Crystals of this sort, with unsummetric Crystals of this sort, with unsymmetric betray the internal strain, either by internal strain Crystals of this sort, with unsymmetric faces, generally betray the internal strain, either by developing electricity of opposite kinds at the two ends when heated or cooled, or they affect polarized light, rotating the plane of polarization. That these effects are due to the internal strain is shown by the fact that tourmalines, and other crystals, which are pyro electric tournalines, and other crystals, which are pyro electric when unsymmetrical, show no such property when sym-metrically grown. Also sodium chlorate in solution, quarter when fused, and so on, lose their rotatory power Substances which in solution show rotatory power, as a rule develop unsymmetric crystals. This is well seen in the tartrates. The constitution of the molecules must be such that they will not, without some strain, form crystals; and equilibrium, when the crystal is growing, is attained by means of the opposing stress due to want of symmetry in the surface-tensions In all such crystals the rotatory power of the solution disappears in whole or in part We cannot test this in biaxial crystals, but, according to Des Cloiseaux, sulphate of strychnine is the only substance which shows rotation both in the solution and in the crystalline form, and in it the rotatory power is much increased by the crystallization. Effects comparable with these may be produced by mechanical means A cube of rock salt, which has no effect on plane-polarized light in its ordinary state, changes the plane of polarization when it is compressed in a vice. And a cleavage slice of prussiate of potash, which is uniaxial, may by compression be distorted so as to give in a convergent beam of polarized light elliptical rings, and two eyes like a biaxial crystal.

THE ERUPTION OF VESUVIUS OF JUNE 7,

DURING the latter part of 1800 and the early part of the present year, the central activity of Vesuvius has very slightly vaned, except about the new year, when it was considerably increased, rasing to the third or fourth degree, simultaneous with the stoppage of the lateral flow. Since then, up to the price of the lateral flow. Since then, up to the price of the lateral recommendation of the lateral flow. Since then, up to the price of the lateral activity has been generally at the first degree, and the cone of eruption has slowly grown in height.

On June 1 there was a crater within the central eruptive cone, of about 50 m in diameter, near the centre of which was the eruptive vent, surrounded by another embryonic eruptive cone. On that day, four small eruptive mouths opened around the embryonic cone in the bottom of the sentral crater, the smallest being to the east.

Thus the volcano remained till June 7, at 10 a.m., when

NO. 1129, VOL. 44]

activity stopped, only a small quantity of vapour escaping from central vents. At midday a radial cleft popend at the north toe of the cone of cruption (May 1889, June 1891) traversing towards its east end, the little sickle-shaped ndge, the remnant of the 183;-86 crater, but, as yet, age wo unlittle vapour. At 4 to 4 to p m, shocks of earth-quake commenced, limited only to the upper alopse to radial fissure down the side of the great Venuvian cone for nearly half its way opposite the Funta del Nasone of Monte Somma, from which, at about 5,30 pm, jusued a little lava, whilst from the upper extremity of the fissure at the toe of the once of crupton much vapour escaped, so that from Naples the smoke-plume arose from this point. From 35 to 7, pm the fissure still extended out the cone of crupton much vapour escaped, so that from Naples the smoke-plume arose from this point. From 35 to 7, pm the fissure still extended qualtes, notices, and the elevation of columns of black dusty smoke At a few munutes to 7 the floor of the Atrio del Cavallo was reached, and a remarkably black column of smoke had arssen.

My friend Dr. L Sambon saw this column arise, and came to inform me immediately, as I had left off watching came to moral me immediately, as I had left off watching the mountain at 5 30. After taking a photo of the mountain, we left Naples at 9 pm, spent some time in in quiries at Resina and near the Observatory Everything was now dark, as the volcano had caimed down at was now durk, as the volcano had caimed down at 8 p.m. At 2 am , June 8, we were at the eastern extremity of the Observatory ridge, and commenced to wend our way across the lava surface towards Monte Somma. We were at the lowest part of the depression at the west end of the Atton del Cavallo, where it joins the Fossa della Vetrana, and along which some of the largest lava-streams have flowed (1855, 1872, &c.), when suddenly on our right above us (2 23 a m.) a vast quantity of bright red vapour arose from the new outpour of lava. We hastened our steps as much as the road and our lantern would allow us, so as to reach the escarpment of Monte Somma, the foot of which was followed till near the Punta del Nasone, and close to the theatre of eruption. Here we clambered up some distance above the level of the Atrio to watch events whilst we ate our late supper or early breakfast. Along the slope of the great cone in the line of fissure were few lumnous points from some pieces of still uncooled lava of the little that had oozed forth from the lower half of the fissure At about 60 or 80 yards from the foot of the great cone two or three fountains of lava were throwing up jets of molten rock for 2 or 3 m, and the lava was slowly spreading out on the almost horizontal plain of the Atrio in several tongues The lava must have still been high in the main chimney, as the vapour that issued at the top of the fissure showed a slightly red illumina-So we remained till daylight, when we could see the fissure on the side of the cone. The mouth that formed at 5.30 the previous day was still smoking a little, whilst the fissure below it sent off several ramifications at an acute angle like the branches of an inverted tree, from several of which little streams of lava had been given out, where they had soon consolidated. We now followed the base of the great cone to the lower railway station, where we found all the people up and dressed, frightened by the strong shock and noises at 2.23 a.m., coincident with the fresh outflow of lava that we had witnessed, but which shocks we had not felt, although they were described as the strongest that had been felt

Having ascended to the summit of Vesuvius, we found the central crater rapidly enlarging by the falling in of its edges. From the new fissure at its summit was issuing much vapour under pressure, and rich in sulphurous acid, which is, even in traces, intolerable; and the hot air coming from innumerable new fissures rendered approach actions to the contract of the

side was equally unsuccessful At some old fumaroles on the 1872 crater plain, I collected some crusts of boric acid and alum, both rare products at this volcano. One of three terminations we may expect to these

One of three terminations we may expect to these phenomena, which are very characteristic of a lateral disruption, so common at Vesuvius.—

(1) Should the lava cool sufficiently to plug the radial

(1) Should the lava cool sufficiently to plug the radial dyke, no further phenomena will occur, and activity will be restored to the central vent.

(a) If this plugging only partially takes place, lava may dribble forth for months, but probably the escape of vapour will soon be restored to the central vent.

vapour will soon be restored to the central vent.

(3) If the rent should widen, considering how low it extends, we may expect a grand eruption which might gival that of 1872, which commenced near the same spot

and much in the same way; the mechanism by which this occurs I have explained elsewhere! My best thanks are due to Mr L Sambon for his company and help, and to Mr E Treuber, Inspecting Engineer of the Vesuvian Railway, for kind information Naples, June 9 H. J JOHNSTON-LAVIS

Naples, June 9

H. J. JOHNSTON-LAVIS

H. J. J. L., "The Relationship of the Structure of Igneous Rocks to
the Conditions of their Formation," Scientific Proceedings K. Dublin Soc.,
vol. v., New Ser., pp. 112-56.

NOTES

A LAKOR and influential meeting was held at Edinburgh on Monday to consider the arrangements which ought to be made for the visit of the British Association to that eity nate year. The Lord Provos presided On the motion of Sir William Turner the following were elected Vice-Presidents —The Lord Provost, the Maquis of Lothina, the Earl of Konebery, Lord Kingsburgh, Principal Sir William Muri, and Prof Sir Douighas Macagian A local executive committee was chosen, and Mr A Gillies Smith was appointed honorary botal treasurer. In a text from Mr Griffith, secretizely of the Association, it was effect to the Mr Griffith, secretizely of the Association, in was facilitied to the secretized of the Mr Griffith Secretizely of the Association, in was facilitied to the secretized of the Mr Griffith Secretized to the Mr

On July 28 and the three following days, at Bournemouth, the British Medical Association will hold its fifty-ninh annual onetting under the presidency of Dr. J. Roberts Thomson. The schenific business of the meeting will be conducted in nine sections. An address in medicine will be given by Dr. Lauder Brunton; an address in surgery by Prof. Chiene; and an address in public medicine by Dr. Cox Seaton.

A PAYSICAL Observatory, furnahed with specially designed apparatis for the protection of investigation in radiant energy and other departments of tellune and autro-physics, has been established as a department of the Smithsonan Institution The communication of new memoris bearing in any way on such researches a requisted, and for them it is hoped that groper return can be made in due time.

THE Standard understands that on the vote for the salary of the President of the Board of Trade, either Sir Henry Roscoe or Sir Lyon Playfair will call attention to the action of the Government with regard to the proposed Institute of Preventive Medicine.

THE Committee of the French Academy has decided, by five votes to four, that the prize of 20,000 francs should be given to M Elhée Reclus, author of the well-known "Nouvelle Géographie Universelle" It is expected that the Academy will railfy the decision.

ACCORDING to a Reuter's telegram from Simla, dated June 22, Drs Rake and Buckmaster have succeeded in cultivating the leprosy bacillus in serum. They were alded in their researches by Surgeon-Major Thomson.

NO. 1129, VOL. 44

Its reply to Mr. Byce, a the House of Commons on Monday, the Lord Advocate stated that it would be the duty of the Government during the ensuing year not only to weigh very carefully the classing of secondary ductation in Socialand as one carefully the classing of secondary ductation in Socialand as one of the interests competing for a share of the additional Socioth or prosecute further inquiries as to the means by which any grant available for that purpose might be usefully applied. Many proposals had already been submitted to and considered by the Socioth Education Department, and these, as well as any suggestions which might be made, would receive well as applied for a supplied of the submitted of the submi

THE funeral of Sir Richard Burton took place on Monday at the church of Sir Mary Magdalene, Morilake The tomb represents an Arab tent, with a crucifix over the entrance. The interior is a small chapel with altar and some Oriental lights.

It has been decided that a Geographical Society shall be formed at Liverpool. A preliminary committee has been appointed, and it has issued a circular stating the objects of the new body.

ACCODING to a telegram sent through Reuter's Agency from Naples on June 16, the flow of the lava stream from Vessuvas had topped, and Sugnor Palmiers, the Director of the Observa tory on the mountain, had expressed his belief that the outflow might be regarded as at an end.

SLIGHT but continuous earthquake shocks were felt at Verona on June 10; and on the 11th, at 8 30 a.m. a very voluent shock occurred at Tregano and Badia Calavena. This was plainly felt in Verona also. Another violent shock occurred at Tregano on the 13th, and on the 15th shocks were reported from Castelnuovo, Peckhera, Somma Campagna, and Desenano

This first volume of a new meteorological Review has been published, containing observations taken in the south-west of Russia for the year 1890. This system was organized by Prof. A Klosowsky, in 1886, and now numbers nearly 600 observers. The observations refer chiefly to temperature, wind, rainfall, see, for chimatological and agracitural purposes. The Review also contains several strictle of importance, $\varepsilon_{\mathcal{K}}$ (1) on phenomena (1) on the harvest in connection with motivation of the contains of the contains of the contains of the contains the Russians language only, the positions of the stations, and various data referred to in the text, are illustrated by maps and diagrams.

Ar a meeting of the Royal Statistical Society, on Tuesday, a paper was read by Mr Noel A. Humphreys, Secretary of the Census Office, on the results of the recent census and estimates of population in the largest English towns. The first part of the paper was devoted to the consideration of the recently-usued results of the census in April last in the twenty-eight large English towns dealt with in the Registrar-General's weekly returns It was pointed out that, although the increase of population within the present boundaries of these Towns showed an increase of nearly a million in the last ten years, the increase was less, by considerably more than half a million (605,318), than would have been the case if the rate of increase had been the same as in the preceding ten years, 1871-81, and that the rate of movement of population showed striking variations in the different towns. The rate of increase in these twenty-eight towns, it was stated, has pretty constantly declined in recent years, and has fallen with scarcely a break during the last five intercensal periods from 24 3 per cent, in 1841 51 to 11'o per cent, in 1881-or. The percentage of increase within the bound-

aries of registration London (practically those of the county of London) declined in the same period from 21'2 to 10'4. The rate of actual decline of population in central London continues to increase, and the rate of increase of the other parts of the metropolis, including even the aggregate outer ring of suburban districts, continues to decline Examined In detail, the provincial towns show, with few exceptions, the operation of similar laws; actual decrease in the central portions, and marked deeline in the rate of increase in the other portions, the latter being specially nonceable in those towns with comparatively restricted areas. This examination, while showing the marked general decline in the rates of increase in these towns, discloses striking variations in the rates of increase in successive census periods Mr. Humphreys called attention to the fact that these striking changes in the rates of movement of population in the large towns interpose the greatest difficulty in estimating, even approximately, their population in intercensal periods. The estimate of population in Liverpool, based upon the rate of increase between 1871 and 1881, excoeded the recently enumerated number by more than 100,000, or by 20 per cent., while in Salford the percentage of over estimate, by the same method, was 26 per cent. recent birth-rates and death-rates in these two towns have been under-estimated by no less than a fifth and a fourth, respectively The various methods that have been at different times suggested for estimating the population of towns in intercensal years, in substitution of Dr. Farr's method, still used by the Registrar-General's Department, were severally considered, and it was shown that no hypothetical method yet devised affords reasonable promise of satisfactory results. It was therefore urged that

AT the meeting of the Linnean Society of New South Wales on April 20, Mr. T. W. Edgeworth David exhibited, on Abalif 20 of Mr. J. E. Carne, Mineratogut to the Department of Mines, Sydney, a speciation of precois opal from the White Cliffs about fifty miles northerly from Wilannius. Precious opal and common ogal have lately been discovered in this locality. In a formation corresponding to the Desert Sandatone of Questiand. The copied secons discensinated as an infillranced cement throughout the mass of the sandatone in place, and also replacing the calcutorous material of fosuit. It also occurs in cracks in the sandatone, and cacinonally replaces part of the original woody tussies of the silicified recommendations.

a quinquennial census could alone supply a remedy for the

present difficulty, which threatens to impair the public faith

in death-rates, the failure of which would most seriously hinder

and imperil the health progress of the country

MRS, J. KING VAN RENSSELAER contributes to the Proceedings of the U.S. National Museum an interesting paper on the playing cards used in Japan They are more distinctly original, she says, than any others, and show no marks of the common origin which the Italian, Spanish, German, French, Hindoo, and Chinese cards display. Forty-nine in number, they are divided into twelve suits of four cards in each suit. One card is a trifle smaller than the rest of the pack, and has a plain white face not embellissed with any distinctive emblem, and this one is used as a "joker." The other cards are covered with designs that represent the twelve flowers or other things appropriate to the weeks of the year Each eard is distinct and different from its fellows, even if bearing the same emblem, and they can be easily distinguished and classified, not only by the symbolic flowers they bear, but also by a character or letter that marks nearly every card, and which seems to denote the vegetable that represents the months. The only month that has no floral emblem is August, and that suit is marked by mountains and warmlooking skies.

NO. 1129, VOL. 44]

PROF. D'ACY W. TROMPSON has delted an interesting volume of "Sudies from the Museum of Zoology in University College, Dundee." The volume constst of the first twelve numbers of a journal in which the zoologies connected with the Dundee University College hope to find "an incentive to their own diligence, a way of communication with the outer world, and a means of gring direction and consecutive purpose to all and a means of gring direction and consecutive purpose to all and a mean first Mary I. Wulker, Prof. H. Lebosco, Dr. H. Si. John Brooks, Mr. Alexander Meek, and Prof. W. K. Parker

An interesting illustration of the antagonistic action of polsons is mentioned in the current number of the Pharmaceutical Journal. Dr Mueller, of Yackandandah, Victoria, has written a letter in which he states, says our contemporary, that in cases of snake bite he is using a solution of nitrate of strychnine in 240 parts of water mixed with a little glycerine Twenty minims of this solution are injected in the usual manner of a hypodermic injection, and the frequency of repetition depends upon the symptoms being more or less threatening, say from 10 to 20 minutes When all symptoms have disappeared, the first independent action of the strychnine is shown by slight museular pasms, and then the injections must be discontinued unless after a time the snake poison reasserts itself. The quantity of strychnine required in some cases has amounted to a grain or more within a few hours Both poisons are thoroughly antagonistic, and no hesitation need be felt in pushing the use of the drug to quantitles that would be fatal in the absence of snake poison. Out of about 100 cases treated by this method. some of them at the point of death, there has been but one failure, and that arose from the injections being discontinued after 14 grain of strychnine had been injected. Any part of the body will do for the injections, but Dr Mueller is in the habit of making them in the neighbourhood of the bitten part or directly upon it

The Rev. J. Hoskym-Abrahall writes to us that on June to, about 10 50 pm., new Woonkinch, he saw what he describes as "a benatiful phenomenon" "Suddenly," he say, "at the carelibe, and of the Great Bear, shone Grish a yellow globe, like Venus at her bnghten. Dropping somewhat alowly, it fell obliquely southward. As it passed in its brilliant eareer, it lighted up its dusky pash with a glorious lastre. When it had deseened about half-way down toward the horizon, to therefore a sparking host of glowing fragments, each dazsingly shot over with all the huse of the rainbow".

THE Register of the Johns Hopkins University for 1890-91 has been issued. It contains a great mass of well-arranged facts relating to the work of that flourishing institution.

MR C FRENCH, Government Entomologist at Melbourne, is contributing to the Victora Naturahit a series of notes on the insectiverous birds of Victoria. In the first paper, which appears in the May number, he describe the Australian Bustard (Charsatia sustraint). Some months ago Mr. French made an appeal to the Victorian Government for the personant protection of this, the most useful insect-destroying bird in the colony. It appeal was supported by the Council of the Zoological Society of Melbourne; and the Government has not only acceded to the request, but has placed the matter before the Government of New South Wales, who, it is hoped, will at once see the necessity for the preservation of a valuable a bird.

DR. A. KORNIC has issued as a separate volume the account of his ornithological observations made during his explorations in Madeira and the Canary Islands. It is a notable memoir, and several new species and sub-species of birds are described. He is somewhat severe on some British ornithologists for having

tried to forestall lam in the description of the Chaffinsh of Plams, which he was the first to discover. The edutor of the fournal fur Ornsthologes, in which the paper first appeared, also adds some strictures on the ways of British naturalists. Dr. Koemig apparently has some grounds for his complaint, but a resease a Regular by his new name of another, though he admits earling a Regular by his new name of another, though he admits that the British Museum "Catalogue of Pirch," in which he will find that his identifications of the Maderan and Canarian Frengilla were all published long before height them to world as new facts. These small outtere do not, however, affect the importance of the essay, which is work do unt he rearstable acre, and is, in fact, a monographic review of the ornsthology of Madera, Teastiffs, and Palms. Eight coloured places tilustrate the

In a paper lately read before the Sclennife Section of the Manchester Literary and Philosophical Society, Mr John Watson maintains that the re-development of lost limbs is not unusual among insects. He hunself has had three cases in which limbs have been re-developed, and one case of complete cicatrization. Re-development, he says, can take place either at the larval of the pupil stages of an insect's neutrophosis

THE British Consul at Hankow, writing of the varnish exported from that city, says he is informed that it is the gum of a treethe Rhut vernicifera. On this tree, before daylight, incisions are made: the gum that runs out is collected in the dark, and strained through a cotton cloth bag, leaving behind a large amount of dirt and refuse. This operation can only be performed in the dark, as light spoils the gum and causes it to cake with all the dirt in it. It cannot be strained in wet weather, as moisture causes it to solidify. When the Chinese use this varnish, they rub it on with a sort of mop, or swab, made of soft waste silk. It should only be used in wet weather, as, if the atmosphere is dry when it is rubbed on, it will always be sticky As used by the Chinese, the varnish takes about a month to dry, and during the time it is drying it is poisonous to the eyes. The Consul thinks that this gum may have been one of the ingredients of the celebrated Cremona varnish, and he suggests that it might be worth the while of musical instrument makers to make expenments with it with a view to producing a varnish that would give a mellow instead of a glassy sound.

THE Insect-house in the Zoological Society's Gardens is now in excellent order, and well deserves a visit. In addition to the Silk-moths that are usually present during the warm weather, the Papilioning, or Swallow tail butterflies, afford at the present time the chief display The perfect insects of several species of the genus Papilio have appeared-P. cresphonies, asax, and asterias from North America, P alexanor from the Mediter ranean shores, and the handsome P. maackss from Japan. The last-named has been seen for the first time in the house this year, and offers a striking contrast to the other species of the genus that have previously been exhibited in the Gardens, it being of black and golden-green colours instead of the yellows and blacks that we are accustomed to in our European Swallowtails. P. cresphontes has appeared in large numbers in the house, but no varieties have been obtained. This also is the first season for two other besutiful Papillonine, viz. Dorstis apollina from Asia Minor, and the Japanese Sericina telamon The latter shows considerable difference in the markings of the sexes. The North American Limenitis disspous can be at present seen in all its stages, and is well worthy of attention, the caterpillar moving along the leaf-stalks with a peculiar interrupted gait. Of the Sphinx moths, the South European Deilephila alecto has already appeared, and D. wice is expected. These insects are, however, not seen to advantage in confine-

ment, as their superb powers of flight cannot be displayed in a small compartment. Two examples of the Orthoptera are alive in the house-Draphemora femorata, one of the Suck- or Twiginsects from North America, and Empusa egena from Southern Europe. The former has been reared from eggs laid in the Insect-house, but these progeny are not so healthy as those obtained from freshly-imported eggs. The Empusa is of a most bigarre form, and belongs to the family Mantides, the species of which feed only on living creatures. The public is Indebted to Mr. S. H. Carver for the opportunity of seeing living scorpions; he has sent examples of two species of this group from Egypt, both of which unfortunately are unidentified, there being obvious difficulties in the way of carrying about live scorpions and comparing them with dried specimens. There is a third scorpion, from South Europe, living with its Egyptian congeners : it has a small delicate tail, and is altogether a less frightful creature. though assuming a menacing attitude with equal readiness. spider, Lycosa portosantana, from Madeira, is healthy, and is a fine creature, though insignificant by the side of its neighbour. a huge Mygale from South America. The latter, as well as the scorpions, is fed with mice, which are given to it dead, though in its native haunts a Mygale has been known to prev on living individuals of these small mammals,

In the current number of the Board of Trade Journal some interesting facts as to cotton cultivation in Russian Turkestan are given, on the authority of a Russian correspondent of the Monde Economique. After the submission of the Khanates of Central Asia, the trade of the country was carried on chiefly with the towns of Russia in Europe, and was confined at first to the export in small quantities of cotton grown from native seeds, of rice, raw silk, and other similar products. It is only during the last ten years that the industry of the country has extended to any considerable degree, owing to the ingress of speculators, and has changed its primitive character. There have been established all kinds of works and factories, and in 1884 the cultivation of cotton of American origin was essayed. This trial succeeded so well that all classes of society, including even public officials, devoted themselves to this culture, which has become one of the chief branches of industry in the country. The new cotton produced in Central Asia is equal to that of America, and finds an excellent outlet among the cotton spinneries and mills of Russia. But the consumption in European Russia does not suffice for the ambitious aims of native producers, and they look forward to the possibility of opening up trade in the foreign markets of Europe.

THE new number of the Internationalist Archiv fur Ethneorgatis fally mantains the reputation of this excellent periodical. Among the contents is a paper in which Dr. J. D. E. Schneilt, continues his elaborate account of the collections from Corea in the ethnographical museum at Leyden. Dr. Hennrich Schurz: has an interesting article on the geographical distribution of negro continues. As usual, the plates illustrating the vanous contributions are most carefully secured.

A FURTHER communication upon the new personde of sulphur, SO₀, by Prof. Trush, of Bireslaw, will be found in the current number of the Bernelle. Thus interesting substance is obtained when solutions of sulphure and containing at least 40 per cent. of and are subjected to electrolysis, as a crystaline deposit upon the anode. The crystals were finit observed some time ago by Berthelot, but were considered by him as identical with the oxide SO₀, which had periodically obtained by the science of the size of the crystal sever finite or supplied to the control of the size electrical dicharge upon a mixture of supplier dicade and tunnel at the anode in the electrolysis of 40 per cent, columns of sulphuric acidd in represented by the formula SO₀, and in quite a different substance from Berthelot's SO₀. It is, as predected by

Mendeleeff, not the anhydride of an acid, but a neutral oxide of a similar chemical character to hydrogen peroxide. It may be best separated from the excess of 40 per cent, acid by removing the latter, after dilation with three times its volume of water, by means of freshly prepared barium phosphate. It cannot, however, be preserved in pure water, as it parts with oxygen so readily, becoming reduced thereby to ordinary sulphuric acid. That it is not an anhydride is proved by the fact that it yields no salts of the type K2SOs with alkaltes. Neutral solutions containing it, in which it appears to be permanent, may be readily prepared by neutralizing the solution in 40 per cent acid with caustic soda, potash, or magnesia. The properties of SO4 in either acid or neutral solution are somewhat remarkable. Whea boiled in contact with platinum wire or platinum black it is energetically decomposed with evolution of quantities of oxygen. If the neutral solution is employed, it becomes strongly acid Indigo solution is oxidized and decolorized slowly, but instantly if a little ferrous salphate is added SO, however, in spite of this ready decomposition into oxygen and sulphuric anhydride, is but a weak oxidizing agent, being incapable even of oxidizing oxalic acid or carbon monoxide But under certain circumstances it acts as a powerful reducing agent For instance, if an emulsion of peroxide of lead in 40 per cent. sulphuric acid is brought in contact with a quantity of similar acid which has been subjected to electrolysis so as to charge it with SO4, a rapid evolution of oxygen gas occurs, and the peroxide of lead is converted into ordinary sulphate of lead. In a similar manner precipitated peroxide of manganese is rapidly reduced to manganous sulphate with evolution of oxygen, and silver peroxide likewise dissolves up to a clear solution of stiver sulphate with violent effervescence due to the escape of oxygen Prof. Traube regards sulphur peroxide as built up on the type SO₂(O₂), resembling hydrogen peroxide, HaO, He considers that Berthelot's oxide, SaO, is a molecular compound of SO, and SO,, for it does not dissolve in water without decomposition, breaking up into sulphuric anhydride and oxygen, which is evolved On the other hand, it appears, like SO,, to be perfectly stable in a moderately concentrated solution of sulphuric acid.

164

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (Macacus cynomolgus &) from India, presented by Mr. James B. Leekie, a White-fronted Amazon (Chrysotis leucocephala) from Cuba, presente | by Mrs. Lacabra; a Radiated Tortolse (Testudo radiata) from Madagascar, an Angulated Tortoise (Chernina angulata), three Smooth-bellied Snakes (Homolosoma Intra.) from South Africa, presented by the Rev G. H. R Fisk, C.MZS, a Green Lizard (Lacerta viridis) from France, presented by Mrs Hill; three Horned Lazards (Phrynosoma cornutum) from Texas, presented by Mr James E Talmage, five Squirrel-like Phalangers (Belideus neureus & & & & Q) from Anstralia, a Grand Eclectus (Eclectus roratus) from Moluccas, deposited, two Elliot's Phensants (Phassanus ellists 9 9) from China, two Rufous Tinamous (Rhynchotis rufescens) from Brazil, purchased; two Marbled Newts (Molge marmorata), bred in the Gardens,

OUR ASTRONOMICAL COLUMN

NEWL-DISCOURSE MERSINGS ON SATURA.—Edinburgh Circular No. fig. useed by Dr. Copeland on June 10, contains Mr. A. Stagley Williams, of Burgess Hall, Susse, hat discovered three deletate but distinct markings in the equatorial argono of Satura. The first and their of these are round bright segroon of Satura. The first and their of these are round bright which they occur. The second is a smaller dark marking on the equatorial edge of the shaded belie which forms the southern boundary of the white zone. Mr. Williams has obtained shear the content of the conte at requires patience and practice to see them readily. It is very

desirable to obtain repeated observations of their times of transit across the planet's central mendian. To facilitate these observations, Mr. Williams has prepared the following table, using 10h, 14 6m. as the provisional time in which the planet rotates On the exist.

Approximate Greenwich Mean Time at which the Shots may be

1851.	Spot z (white)	Spot 2 (dark)		Spot 3 (white).	
	h m	h m.		h m	
June 20	7 50	 8 47	••	10 9	
21	 4 20	5 17		6 39	
22	11 5	12 2		13 24	
23	7 32	 8 29		9 51	
24	4 2	4 59	.,.	6 21	
25 26	10 47	11 44		13 6	
26	7 14	8 11		9 33	
27	3 44	4 41		6 3	
28	10 20	11 26		12 48	
29	6 56	7 53	٠.	9 i5	
30	3 26	4 23		5 45	
July 1	 10 11	ı i 8		12 30	
	6 38	7 35		8 57	
3	3 8	4 5		5 27	
4	9 53	10 50		12 12	
5	6 20	7 17		8 39	
ş	2 50	3 47		5 9	
7 8	9 35	10 32		11 54	
8	6 2	6 59		8 21	
9	2 32	3 29		4 51	
10	0.17	10 14		11 26	

THE ROTATION PERIOD OF VENUS -The Bulletin de l'Aca-THE ROTATION PERIOD OF VENUS—The Buildish de l'Aud-deun Royale de Belgaun, No. 4, coatanns a paper, by M. Niesten, of Brussels Observatory, à proper the rotation of the planet Venus. The observations and drawings made by M. Suyvaert and the author from 1831 to 1890 do not appear to confirm the persist-ence of the dark markings during a long period, as found by Schinparelli and other. It is also shown that De Vico'l period. of 23h. 21m 21'93s, is more in accordance with the observa-tions than Schiaparelli's period of 224 7 days Twelve drawings of the planet, and a map showing all the markings, accompany

A NEW ASTEROID (10) -M. Charlois discovered the 310th minor planet on May 16. Its magnitude was 13.

THE ROYAL GEOGRAPHICAL SOCIETY.

THE ROYAL GEOGRAPHICAL SOCIETY.

THE answersy meeting of the Royal Geographical Society
The answersy meeting of the Royal Geographical Society
The first basis of the Royal Control of Monday after
noon, the Forestee was the award of the medial and obten
honour for the year. The Founder's Medial was delivered to
So Dillon Bell, Agent-General for New Zealand, for transmisSor Dillon Bell, Agent-General for New Zealand for transmisreceived the Parton's Medial on behalf of Dr. Fridgity Nasson,
New Zealand Geological Survey. The Swedish Minister
received the Parton's Medial on behalf of Dr. Fridgity Nasson, ho was unable to attend. Other hogours were awarded to Mr. who was nable to attend. Other hosours were awarded to Mr. Wilsam Gylter, for his explorations of the Mackemase and Yukon with the exploration of Nyssaland, Mr. A. E. Pratt, for his pourneys in Sechuen; Mr. W. J. Stealas, for his investigations on the Rio Doce, South America. Mr. H. J. Mackinder then introduced the students of the Training Colleges who had been successful ia obtaining the prizes offered by the Society annually on the results of the Christmas examinations in geography. Mr. Mackinder spoke briefly on the progress of geo-graphical education, and on the results of the four years' awards to the Training Colleges

The Secretary then read the annual report of the Society, from which it appears that on May I last the total number of Fellows which is appears that on May I last the total number of Fellows was 3579, being a net increase of \$6, on the previous year. The total income up to the end of December 1890 was 19531, and expenditure 1820. The estimated value of the Society's investments is 12,568, and of its total sasets 16,628. During the past year, 900 books and pamphlets have been added to the illurary, and 936 sheets of map to the map collection, besides 25 atlases, 700 photographs, 151 lantern-slides, and 51 views.

The President then proceeded to deliver the annual address on the progress of geography during the past year, dealing mainly with the explorations which have been carried on in

various parts of the world.
"The year," he said, "of which I am about, with your permis-"The year," he said, "of which I am about, with your permis-sion, to give some account, has not been, so far as geographical discoveries are concerned, a very brilliant or sensational one Brilliant and sensational years are, also hikely to grow fewer and fewer as the globe we inhabit becomes ever better known and fewer as the globe we inhabit becomes ever better known to it. If, however, the year has not been made mem rable by much extensive exploration it has put to its credit no small amount of instensive exploration. A good many gaps in our knowledge have been filled up, and a great deal of solid useful work accomplished. All this healthy activity has been represented in our Proceedings, and much of it has found its way to santed in our Proceedings, and much of it has found its way to un'fellows through the papers which have been read in this theater. Many of these have been extremely interesting. If Cogleg's journey to Uganda, Colonel Tanner's observations on the Hunslayan Range, and Mr. Pratt's journey to Succhuen These last were distanted, at it will be remembered, by drawings and by photographs of exceptional ment, which were examined correlately by large namelyes after our examined correlately by large nameless after our neetings closed examined caretury by targe manuals and the auditors, the total assets of the Society have considerably increased, and we total assets of the Society have consuderably increased, and we are in a position to give most efficient assurance to any tho-roughly well considered whether which are laid before us. I although we are rich, if is not not the less our day to cartuinte carefully all proposals which are made to us, and to see that the money which they give so generously is applied only to really promising objects. Such we considered to be Mr. Kaussay's explorations in Asia Minor, and Mr Theodore to really promating objects. Such we considered to be the control of the control are being crowned with success, thanks to the enigenency towers now prevailing there, to the powerful assistance of the Warden of Merion and other friends in high place, and to the zeal and high intelligence of Mr Mackinder, who is rapidly winning not only golden opinions for himself, but an excellent place for his senence on the banks of the Iss. Negotiations are Negotiations are place for his scenece on the banks of the fass 'Negotasuous are mown in progress which will, I hope, result in the establishment of a Traveling Scholarship at the joint expense of our Succept of a Traveling Scholarship at the joint expense of our Succept when the progress of the Succept Scholarship at the joint expense of our Succept Scholarship at the progress of the Succept Scholarship at the S able ways

The President then proceeded to review the exploring work of the year, most of which has already been dealt with in NATURE.

PARKA DECIPIENS

THIS very interesting fossil is derived from various localities in Scotland, all of which are believed to be Lower Devonian. It was first described in 1831 by Dr. Fleming, and the the beau recorded on the state of since then has been noticed on several occasions, and variously

1 "Notes on Specimens from the Collections of Messre Graham and Reid, by Sir Wm. Dawson, LLD, F.R.S., and D. P. Penhallon, B.Sc. F.R.S.C. Abstract of a paper read before the Royal Society of Canada May 1891

NO. 1129, VOL. 44

regarded as the spawn of Mollusca or Crustaceans, and as of

regarded as the spawn of Mollusca or Crustaceans, and as of wegetable origin.

The material upon which the present observations are based was collected by Mr. James Read and Mr. Walter Graham, both of whom have offered many valuable suggestions as to the probable nature and affinites of the fossil. As found, the Tair ha deraption usually consists of oval masses bearing rounded impressions or data-like bodies of carbonaceous matter. Assomether than the contract of the contra impressions or disk-like bodies of caroonaccous matter. Asso-cated with these are also stems and linear leave of two dimen-sions, and a third form having a general resemblance to Pachy-theca, which is found in the same beds, and differing from it in having a more discold form, and being devoid of structural

The authors show that the fossil is probably a rhizocarp allied to Pulularia, and that there are at least three forms recognizable, of which one is referred to the species, and the other two to varieties. The views thus stated are based upon differences of size and upon the fact that certain of the disk bodies show spores of two kinds, and in some cases prothall in various stages of development, all derived from the same sporocarp

The paper is illustrated by a plate of figures

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE -In the list of the Mathematical Tripos (Part It) Mr. Bennett, of St John's, the Senior Wrangler, Mr. Crawford, of King's, the fifth Wrangler, and Miss Philippa G. Fawcett. "above the Senior Wrangler." are placed in the first division of the First Class.

SCIENTIFIC SERIALS

The American Milestrational formula for May contains the following articles —Cold waves, by Prof T Russell. In the report of the Chief Signal Officer for 1889, he expressed the view that the origin of cold waves was due to mixture of upper and lower air causing cooling of the layer next to the ground. On further examination of the subject, in connection with the observations at mountain station, he admits the incorrectness of those views, and states that, while it is essential to connect the low temperature and high pressure in some way, the cooling of the ground by radiation, and of the air by contact and conduction, will not completely explain the cause of cold waves -How tion, will not completely explain the cause of cold waves—How could the Weather Service best promote agriculture?, by M. W. Harrington The American Weather Service has hitherto devoted itself more particularly to the interests of commerce, while the State Services have had the interests of farmers more distinetly in view What the farmer wants to know is, where and tinctly in view What the farmer wants to know is, where and when a local shower will fall. While the complete solution of this problem may be impossible, the approximate solution has in the multiplacation of local forecasting stations, and in the intelligent use of the indications of the Central Office, combined with the indications which he can himself observer. The author recommends more attention to climatology as distinct, from recommends more attention to climatology as distinct from weather changes, and to the relations between plants, soil, and meteorology,—Is the influenza spread by the wind?, by H. H. Hildebrandson. This is a translation, by the author, from an article in the Journal of the Medical Society at Upsala, and is, practically, a reply to an article in NATUREOF December 19, 1889, where it is stated that the mailedy is probably spread by the wind. The author shows, by a map and table, the places and dates at which influenza occurred in Sweden, from inquiries of medical men The result of the research goes to show that the influenza is propagated by infection, that it is conducted from place to place through human circulation, and that the time of incubation is two to three days. The state of the weather seemed to have no influence on the spread of the malady; in fact, it raged with the same severity in countries possessing very different climates, and during very different weather conditions.

SOCIETIES AND ACADEMIES. LONDON.

Royal Society, June 4 - "On a Determination of the Mean Density of the Earth and the Gravitation Constant by means of

⁴ Mr Reid acknowledges his indebtedness to Mr Langlands, the lessee of Myreton quarries, whose kind permission to examine these quarries was as freeby granted.

the Common Balance." By J. H. Poynting, D. Sc., F.R. S., Professor of Physics, Mason College, Birmingham.

In a paper punted in the Proceedings of the Royal Society, No. 190, 1979, an account was given of some experiments. No. 190, 1979, an account was given of some experiments and the second of are known. Having found G, we may determine the mean density of the earth, for, assuming that it is a sphere of radius R, the weight of any mass M' at its surface is

$$G \times \frac{1}{2}\pi R^2 \Delta M'/R^2$$

= $\frac{1}{2}G\pi R \Delta M'$.

But if g is the acceleration of gravity the weight of M' may be expressed as M'g. Equating these values, we get

$$\Delta = \frac{1}{6\pi R}$$

Method of Using the Common Palance,—With the length of beam used (about 12 cm) a differential method was applicable, beam used (about 12 cm) a differential method was applicable, as perment masses of lead and actionmony, about 21 kloss, such, were buing from the two arms of the balance, so that their centres of the state of the was calculated and allowed for

The alteration in the weights of the attracted masses, due to the motion of the attracting masses from one side to the other, was the quantity to be measured. When this was determined in the lower position of the attracted masses they were raised to in the lower position of the attracted masses they were raised to about double the distance, and the attraction again determined. The difference eliminated the pull on the beam, suspending wires. &c. To lessen the effect of want of homogeneity or sphericity in the masses, or of want of symmetry in the turn-table, the masses were all inverted and changed over each to the

table, the masses were all invertee and canaged over sean to use other side, and the weighings repeated.

The position of the beam was determined by the reflection of a scale in a mirror used with "double suspension." The mirror was suspended by two silk threads, one attached to the end of the ordinary pointer about 60 cm. below the central knife edge, the other parallel to it, being attached to a fixed support.

The mirror turned through an angle about 150 times as great as that through which the beam turned, and one scale division corresponded to an angle of tilt in the beam of about 2/15ths of 0.50

a second. The value of a scale deviation was determined by the use of The value of a scale deviation was determined by the use of wind the office of the configuration of the large beam. When one rider was placed on one supporting frame the other was at the same mainst filled off the other frame. The balance was left free throughout a sense of weighings and no morning parts of the appraisate were connected with

the case.

The values obtained are as follows :---

The gravitation constant $G = \frac{6.6984}{1}$ Mean density of the earth & = 5'4934.

In the paper a description is given of a new form of NO. 1129, VOL. 44]

"Quadrant Electrometers," By W. E. Ayrton, F.R.S., J. Perry, F.R.S., and W. E. Sampner, D.Sc.
In 1886 it was noticed, on continuously charging up the needle of Sir William Thomson's bifair suspension quadrant electrometer No. 5, made by Mesar, White, of Clargow, and in use at the laboratories at the Central Institution, that the in See at the laboratones at the Central Institution, that the deflection of the needle, where the same F.D. (potential diffractions) and the needle, where the same F.D. (potential diffractions) are same for the same form of the same form of the same for a large charge on the needle as well as for a sami, the semblity of the instrument was small. A similar effect had seen that the same for the same form of the attraction of the needle, which wares with the square of the needle's charge, increases the pull on the biflar suspen-sion, and so for high charges more than compensates for the increased deflecting couple due to electrical action. On rassing, however, the needle of our electrometer much above the centre however, the needle of our electrometer much above the entire of the quadrants, the anomalous variation of sensibility of the instrument with increase of charge in the needle did not districted the control of the con

The needle was carefully weighed, with the platinum wire attached and the weight dipping into the acid, and a calculation was made as to the magnitude of the effect that should arise was made as to the magnitude of the effect that should arise from the change of the pull of the Bree due to any upward or downward attraction of the needle by the quadrant. That continue the properties of the pull of the pull of the state needle and the quadrants, the amount of such attraction was quite unable to account for the observed diministion of sensi-toring the pull of the pull of the pull of the pull of the state of the pull of the pull of the pull of the facts at the pull of the pul rate in our specimen of the quadrant electrometer, the principal

rate in our specimen of the quadrant electrometer, the prancipal part of the anomalous action was not caused by an increased issues not of the fibres, and that therefore some other cause must be looked for to explain the observed results. We therefore decided to make a complete investigation of the laws connecting the variation of the sensibility of the instrument with the potential of the needle, the distance between the fibres, the distance between the quadrants, and the position of the needle.

The results of the investigation, briefly summed up, are as follows :-

(1) The quadrant electrometer, as made by Messrs White, (1) The quadrant electrometer, as made by Messrs White, although it may be acceptable adjusted for symmetry, does not neatly even approximately obey lie recognized law for a quadrant electrometer when the potential of the needle is altered. (2) The peculiarities in the behaviour of the White electrometer when the properties of the White electrometer when the white white white the properties of the White electrometer when the properties when the

meter are due mainly to the electrical action between the guard tube and the needle, and to the slight tilting of the needle that occurs at high potentials.

(3) By special adjustments of the quadrants of the White electrometer, the sensibility can be made to be either nearly independent of the potential of the needle, or to be directly proportional to the potential, or to increase more rapidly than the potential of the needle.

(4) By altering the construction of the instrument, as described, the conventional law for the quadrant electrometer is obtained without any special adjustment of the quadrants beyond that for symmetry, and the instrument is rendered many times as sensitive as the specimen we possess of the White pattern.

Linnean Society, June 4.—Prof. Stewart, President, in the chair—After nominating as Vice-Presidents Mr. A. W. Bennett, Dr. Brathwatte, Mr. F. Crisp, and Dr. St. G. Mivart, the President took occasion to refer to the loss which the Society had President took occasion to reter to the loss which its Society had sustained by the recent death of a Vice-President, Prof. P. Martin Duncan, F.R.S. His genial presence at the meetings, no less than his valued contributions to the publications of the Society, would, he felt aure, be missed by everyone.—Sir Walter Sendall, who was present as a visitor, exhibited a curious cocoon of a unth helonging to the genus Times, and made some remarks on its construction and specialtic coloration—The President exhibited a case of Leptodeptra and Colorates, which he had selected to illustrate some of the more notable secondary sexual characters in insects, and made some unteresting explanatory of Months of the Colorate of the Colorate of Months of the Colorate of the Colorate of Months of the Colorate of the Col

EDINBURGH.

Royal Society, May 18 -The Hon, Lord Maclaren, Vice-President, in the chair. -Dr. Buchan read a paper on the barometer at Ben Nevis Observatory, in relation to the direction and strength of the wind. In arranging the results, Dr Buchan has referred the direction of the wind to sixteen points of the compass, although the observations are actually made with reference to the thirty-two points. The readings of the barometers at the high level and the low level stations, when reduced to sea level, exhibit marked differences dependent upon the direction of the wind. The Investigation extends over the the direction of the wind. In a investigation extends over the period of nine months commencing in August 1sst. During that time, all the very high winds have been from the east-outh east and the south-east, these being the directions in which the wind blows freely along the top of the mountain to the Observatory. In eleven cases the wind from these directions attained a speed of 120 milet an, hour or more, and the (reduced) barometer at the high level station read about one eath of an inch lower than the instrument at the low level station In no other direction was a higher velocity than 70 miles an hour noted, and in the directions from west to north-northbour noted, and in the directions from west to north-north-west, cast, and est-north-east, we belong was never greater than 30 miles an hour. With northerly winds the instruments at the top of the mountain record as much lower speed than that which, from observations of the drift of the clouds, is seen to be reached at a small height above the top of the mountain. The case of this comparative calm immediately at the top as the mapper of the air upon the face of the chird which lies to the north of the Observatory. The stream have are then weldered to the control of the control of the chird which could be a support of the chird. defected appareds. In such cases the depression of the bar-ometer is about three times ag reat as that which cours with an equally strong wind from other directions, and indicates the for-man of the strong time. The strong course is a strong popular popular result which is observed with other directions of the wind is that the (reduced) high level barometric reading exceeds he (reduced) to revel reading when the want blows as about the speed of the wind exceeds that rate, on the one hand, or is extremely small, on the other. This seems to indicate an in-tercent time of the strong course of the speed of the speed of the speed of the wind exceeds that rate, on the one hand, or is extremely small, on the other. This seems to indicate an in-tercent time of the strong time of the speed of the and to may explain the fact that the top of the mountain is and to may explain the fact that the top of the mountain is and to may explain the fact that the top of the mountain is and to may explain the fact that the top of the mountain is and to may explain the fact that the top of the mountain is and to may explain the fact that the top of the mountain is and to may explain the fact that the top of the mountain is meant of the leaver, while dense cloud is being constantly formed at a about distance above it.—Dr. J Berry Hayeraft gave an entirely of the strong time of the strong time of the strong time of the mean of the leaver time of the strong time of the strong time. ments of the heart, which since Harvey's time are supposed to ments to the neart, which since travey a time are supposed to take place with every contraction, do not really occur in the unopened chest, and (3) that the cardiogram has been missister-preted by physiologists I it is usually supposed that, during each contraction, the heart twists towards the right while its spex moves forward, and, pressing against the wall of the chest,

causes the "apex beat." Again, it has been supposed by some that, during expansion, all diameters of the heart are not increased, but that, on the contrary, one diameter is diminished in creased, but that, on the contrary, one diameter is diminished in length. Dr Haycrafi's experiments show that all diameters are increased during expansion, and that all are diminished during contraction. They show also that the motions, above described, do not occur in the unopened chest. The heart, in described, do not occur in the unopened enest. The heart, in order that it may be observed in the opened ehest, is necessarily separated from its attachments and falls towards the back of the separated from its autactments and tails towards the said of the chest (the animal operated upon being supposed to be placed upon its back) During expansion, the heart becomes flaced, and so is flattened against the back of the chest and so is flatiented against the back of the chest. The first effects of the suffraing which occurs during the muscular contraction is therefore an elevation of the heart, against gravity, cowards the frost of the chest. Similarly, if the animal be found to the chest of the chest of the chest of the chest, and the "beat" can even be made to take place towards the back. In the unopened whest, the heart on the whole remains in position drang contraction, and therefore it is boundaries move from the chest walls. The first But the cardiogram, as usually interpreted, shows that the chest wall is thrown outwards by the impact of the heart during conwall is thrown outwards by the impact of the heart during con-traction. Dr Haycraft asserts that this is due to deformation of the heart by pressure of the chest wall when the button of the cardiograph is pressed against the exterior of the chest. The hist effect of the mucular contraction and stiffening of the heart is therefore increased pressure against the chest-wall, which gives rise to the up-stroke of the cardiogram. When the cardiograph is made as light as possible, the up-stroke is greatly diminished, but it never entirely vanishes, because the fitch heart is always slightly distorted by the chest wall even when the cardiograph is not pressed against it Dr Haycraft further hows that the sinuosities, which always appear to a greater or less extent on the cardiogram, are not due to peculiarities in the action of the heart, but are instrumental in their origin, being caused by oscillations which result from the inertia of the caused by oscillations which result from the mertis of the cardiograph—Dr. High Robort Mil read a paper on the chemical composition of its vaters. He described records, and discussed observations, made by himself and other members of the staff of the Scottah Marine Statoo. The observations deal the staff of the Scottah Marine Statoo. The observations deal the staff of the Scottah Marine Statoo. The observations deal read that the staff of the Scottah Marine Statoo. The observations deal read that the staff of the Scottah Marine Statoo. The observations deal read that the staff of the Scottah Marine Statoon and the staff of the Scottah Statoon and the staff of the staff of the Scottah Statoon and the staff of the staff of the staff of the sta trated by a manymetric chart of the consignation of the see area, with a special account of the various loci basins. The area and volume of each of these depressions are calculated, and the area of land which drains into each of them is measured on accurate maps. The rainfall is discussed in detail, and the river accurate maps. In erannal is discussed in detail, and the river discharge is calculated indirectly, tables being drawn up to show the volume of rain water which flowed into each of the lochs during each month of the year. The month of maximum rainfall over most of the area is January, that of minimum rainfall full over most of the area or most of the state of the st the Indward, and seven in the seaward division), at which obser-vations were registry made, are described. The method of various reverse registry made, are described as the method of density by means of a Challenger-type hydrometer, are given in detail. A record of 850 determination of density made during twelve timps, which estimated over two years, are given in an individual of the configuration, to the configuration of destination of distingt to configuration, ticke, and rainfall, and which exhibit the relative amounts of pure sea-water and of fresh water which were present in each of the division of the six areas a certain were present in each of the divisions of the sea area at certain selected times. It was found that the amount of sail present in the water of the Clyle sea area vanes with the season, the means are fully friendly and the present product of the common season of the common season of the common season of the common rainfall. The surface water exhibited the greatest changes, the seasonal variations being more regular at greater depths. Even at the head of lochs 50 or 60 miles distant from the open sea the percentage of pure sea-water present was rarely less than 88, the fresh reverwater which powerful an encommon volume after heavy narm rapidly mixing powerful an encommon volume after heavy narm rapidly mixing

with the sea-water, which was constantly renewed by the tide. So rapid and complete is this process of interchange, that the So rapid and complete is this process of interchange, that the amount of vier-water actually present dilating the sate of this amount of vier-water actually present dilating the sate of the through it every year, and is not equal to half of the average ratificial. In an average year 172 cubic miles of water, 975 per cent. of which is pure see water, and 2 per cent fresh-water, cent. of which is pure see water, and 2 per cent fresh-water. The state of the sate of the sat One of these us the thorough manutum of the 10 two cutters.

One of these us the thorough manutum of the bottom to surface as it pours arous the shallow bag at the mouths of the lochs. The saltest surface water was always cond at flood-the, off Otter Spit in Loch Pyne, where the salt water was of the channel of the control of the control of the channel of the control of the channel of the chan

Academy of Sciences, June 8 — M. Duchatre in the chast.—On the currents which give rise to cyclores, by M. H. Faye. The views held by Dr. Hann and Prof. Ferrel concerning cyclores and anticyclones are compared. The department of the concerning cyclores and anticyclones are compared. The department of the concerning cyclores and anticyclones are compared. The department of the cyclores are compared to the concerning cyclores and anticyclones are compared. The department of the department of the cyclores due to temperature have nothing to do, and he shows that they depend on the general more ment of the attempting the cyclores due to temperature have nothing to do, and he shows that they Faye agrees with Dr. Hann —Note on the presence of the Faye agrees with Dr. Hann —Note on the presence of the Faye agrees with Dr. Hann —Note on the presence of the Faye agrees with Dr. Hann —Note on the presence of the Faye agrees with Dr. Hann —Note on the presence of the Faye agrees with Dr. Hann —Note on the presence of the Control of the C develops the equation of condition to be infillfed by radiant-point belonging to the same family of meteors. According to Mr. Denningé observations, the Persed radiant-point moves a probable by Leverrier in 1871. This is in conformity with the equation of condition, which shows that if the latitude of a radiant-point varies slightly the longitude increases.—On two radiant-point varies slightly the longitude increases.—On two functions of the first order form the integrals, by Mr. F. Caspar,—Determination of the mechanical equivalent of heast, by M. Constantin, Meulesco. The method adopted was similar in with the contraction of the mechanical equivalent of heast, by M. With the contraction of the mechanical equivalent of a colorie in kidogram-enter—Debetterin properties of incis as thigh tens-is that the disjective constant a almost invariable for rapid alterna-tions.—Application of the principle to the transmission of pressures tions. - Application of the principle of the transmission of pressures tions.—Application of the principle of the transmission of pressures to widely separated telephone transmitters, by M. P. German.—Action of ammonia on some compounds formed with halogen astits of mercury, by M. Raoul Varet. The author has studied the action of ammonia on compounds formed with mercury loading and metallic cyanides, with the idea of determining the **We of certain compounds of ammonia in double decompositions
-On a new method of preparing silicon chloro-iodides, by
M. A. Besson —On three cases of free development observer in Bryozoas ectoproctæ, by M. Heuri Pro uho .- On the locusts

of Algesta, by M. Charles Brongniart —On the morphological nature of the phenomens of teendation, by M. Léon Guignaud. In results from the observations that the phenomens of Genudation consists not only in the copolition of two nuclei of different sexual registrations of the phenomens of the observations of the phenomens of soil different sexual registration of the make and the female cell —On the inclosures of nephaline of the make and the female cell —On the inclosures of nephaline semants found in the middle of phonolites from Holpsta and in some other beds; conclaimons to be drawn from them, by M. A. Lecroux.—Observation of the parallism of Upper Createous notices of the Western Lyreness (Lower Pysades and Institute of the Institute of Institute of the Western Lyreness (Lower Pysades and Institute of the Institute of the Western Lyreness (Lower Pysades and Institute of the Western Lyreness (Lower Pysades and Institu

BOOKS, PAMPHLETS, and SERIALS RECEIVED

BUOKS, PAMPHLETS, and SERIALG RECEIVED

Glaspase of Networ Dr. A Wisso, Chalon—Reversions of the InnurS B d) Sektamery (Stock)—Tystem and all about Them, a voil J R

Phylosos (Rechards—De-Varianderthan der Tamperana of Serrich
J Kann (Wann)—Monograph of the Broth Contained by E-1 (Grother Contained to the Con

CONTENTS.							
Egyptian Irrigation	. 14	5					
Physiological Psychology. By J. S	14	5					
Achievements in Engineering By N J. L		7					
Geological Excursions. By T. G. B	. 14	9					
Our Book Shelf:							
Meyer "Across East African Glaciers"	. 14	9					
"Chemistry in Space"	. 15	0					
Lettere to the Editor:-							
Erratic Track of a Barometric Depression (With	a						
Chart.)-Rev W. Clement Ley	. 15						
The Crowing of the Jungle Cock -B P Cross .							
Cordylophora lacustres Thomas Shepheard							
Philosophical Instrument Makers - A Hilger	15	1					
The Earthquake of June 7 -Prof A Riggenbach							
Burckhardt	. 15	ı					
Note on Egyptian Irrigation. By Sir Colin Scot							
Moncrieff, R.E., KCB	15						
The Second Ornithological Congress		3					
The Imperial Physical and Technical Institutions							
Berlin	15	4					
Crystallization. (Illustrated.) By Prof. G. D. Livelng	,						
F.R.S	15	0					
The Eruption of Veauvius of June 7, 1891 By Di							
H. J. Johnston-Lavie	. 16						
Notes	. 10	I					
Our Astronomical Column:-	. 16						
Newly-discovered Markings on Saturn							
A New Asteroid (81)							
The Royal Geographical Society							
Parka decipiens, By Sir Wm. Dawson, F.R.S.	. 16						
University and Educational Intelligence	. 16						
Scientific Serials							
Societies and Academies	. 16						
Books, Pamphlete, and Serials Received	. 10	8					

THURSDAY, JUNE 25, 1891.

EDUCATIONAL ASPECTS OF FREE EDUCATION.

N innocent outsider would naturally suppose that the discussion on a proposal for free education would turn chiefly on educational and social considerations So long as the question was of merely academic interest, this was, to a large extent, the case. It is true that strong Churchmen viewed with distaste a change which might increase the growing difficulty, found by voluntary school managers, of making both ends meet, or might possibly even sweep them off the board altogether. and that the enthusiasm of many partisans on the other side for the remission of fees was heightened by the hope that such a measure would give a new impetus to the formation of School Boards But, on the whole, the disputants made at least an attempt in public to discuss the matter in its bearings on the child, the teacher, and the parent. The overburdened parent, the pauperizing effect of partial remission, the child kept from school because of his parents' poverty, the teachers converted into tax-collectors-these were the stage properties of the one party; while the stock-in-trade of the other side included the sacred necessity of guarding "parental responsibility," and the assertion that no one values what he does not pay for, and that to tax the hard-earned sayings of the respectable middle-class to free the education of the children of the worthless and unthrifty was a Socialistic proposal of the crudest kind.

We now find that most of this talk was pure cant It ceased to be heard from the moment when free education became a practical party question To outward appearance the contest over the Bill has become a kind of Terusalem race- everyone wishing to leave to someone else the unpleasant task of formulating the criticisms with which he secretly sympathizes, but to which fear of his constituents prevents him from giving utterance

If we could induce the parties to break through this conspiracy of agreement, we should find that, with a few exceptions, the point on which the advocates feel most keenly is the possibility of using the Act as a lever either to destroy or to perpetuate for ever the voluntary school system In spite of the apparent calm, the battle between the supporters of School Boards and voluntary schools is raging fiercely below the surface, and most of the amendments put down for the Committee stage are certain to represent attempts, more or less open or disguised, to wrest the provisions of the Act to suit the purposes of one or the other party.

It must be confessed that this is to a great extent natural. The Act of 1870 was a compromise; the present Bill virtually reopens the question, and it is felt that, whatever be the logic or want of logic in the argument that Imperial grants should involve local control, the time when large additional grants are being made to voluntary schools is the time, if ever, to drive home the question of popular management. We do not then. quarrel with those who feel that the opportunity must not be lost of raising this question; indeed, we should respect them more if they raised it more openly. But we do | Bill) should be also admitted free, or at least sufficient

protest against the almost total omission of all educational considerations in the arguments used on both sides.

It is time that the third party to the dispute-the real friends of education-made themselves heard. Their one object is to see that the educational benefits of the measure should be maximized, and the incidental evils minimized They ask what is to be demanded in the shape of increased efficiency in return for a new grant of (2,000,000 to school managers Is a great part of it to be allowed to be absorbed by the reduction of private subscriptions and rates, or is it to be used to improve the children's education, and make it a better preparation for their future industry?

In the rural districts, the grant in lieu of fees will almost universally be in excess of the income now received from fees There will therefore be a surplus in the hands of the managers, or manager--for very often these schools are in the hands of one man Where will this surplus go? In our opinion some method ought, if possible, to be found of "ear-marking" it for education rather than for subscribers' pockets. If this were done, nearly the whole of the rural schools of England might be raised in character It would be possible, for example, to introduce, with the aid of the new surplus, some simple teaching in agricultural subjects, such as is recognized in the Code. but is at present a dead letter, for the increased grant would be quite enough to pay a competent travelling teacher to give such instruction in a group of schools If there were universal county of district school authorities, it might be well to hand over the surplus grant into their hands, to be used solely for the improvement of the various schools on whose account it was paid. As, unfortunately, our organization is piecemeal, we are forced to deal direct with each school, and we can therefore only appeal to public-spirited managers to take care that the children for whose education they are responsible reap the full advantage of every penny which they receive over and above the present fees charged It is to be feared, however, that in many cases the managers are at the mercy of their subscribers, and many of them would probably now welcome the proposal made by the Bishop of London, but foolishly rejected by his clerical friends on the late Royal Commission -that a certain minimum of private subscriptions should be required by law in the case of every voluntary school. If such a provision were in force, school managers in the country would be saved many anxious forebodings at the present time

The second point in the Bill on which educational reformers should fix their attention is the limitation of the benefits to children between five and fourteen. The lower limit need not trouble us, and may be left to be worried by the "poor man's" numerous friends the upper limit should be resolutely opposed. quite true that at the present time it is of comparatively little importance-only affecting some few thousands of children But if one of the great objects of educational policy is to lengthen the period of school life, the handful of children at elementary schools above fourteen should certainly not be fined for staying there, if anything, they should receive scholarships to enable them to do so In our opinion, moreover, ex-seventh standard children (who are not for the most part touched by the present

scholarships should be provided to enable any poor child who has passed the standards to continue his education either in the school or elsewhere. We do not say that such scholarships should be universally provided out of the present grant, but they would be a most proper object to which to apply part of the surplus which will be handed to many schools over and above the fee equivalent. These considerations suggest another possible way of dealing with the surplus grants great object of those who are interested in the development of higher elementary, technical, and secondary education should be to strengthen instead of weakening the connection between primary and higher schools. It is to be feared that any provision for freeing elementary schools up to a certain point or a certain age, will tend to sever rather than to un to the two grades of schools, unless the flow between them is at the same time stimulated by the establishment of free scholarships or in other ways A free (or partly free) elementary school is not the ultimate ideal. We want a free road kept open to the University Is it too late to throw out the suggestion that school managers receiving a fee-grant in excess of the amount previously received in fees should be required to use the surplus for an object akin to that contemplated by the main provisions of the Bill-viz the extension of free education for selected scholars beyond the narrow limits of the primary schools, in other words the provision of continuation scholarships? Up to a short time ago it would have been replied that in many cases there were no higher institutions accessible, but the application of the Local Taxation grant to technical and secondary education is fast changing all that, and a proposal which a few years since would have been unfeasible is now well within the range of practical politics

DIFFERENTIAL AND INTEGRAL CALCULUS

Differential and Integral Calculus, with Applications
By Alfred George Greenhill, MA, FRS. Second
Edition (London Macmillan and Co, 1891)

PROF GREENHILL is known to the academic world as an accomplished mathematician who has powerfully helped to advance certain branches of applied mathematics, he is also known to the readers of N sturke as a friend (militaril) of the practical man. We say at once, in all sincerity, that we sympathize with Prof. Greenhill in both his capacities. The volume on the infinitesimal calculus now before us, although professedly a second edition, is in reality a new work, addressed to the special needs of the practical man by his mathematical friend Prof Greenhill.

of many of the author's didactic innovations we highly approve. The treatment of the differential and integral circliculus together from the very beginning is a piece of sound method, the introduction of which has been delayed method by the transpent practice of separating the two as examination subjects. The introduction of the hyperbolic functions to systematize the integrations which can be performed by means of the elementary transcendents, has been, as we can testify from experience, a great help in elementary teaching. The admirable "chapter in the mitegral calculus" which was sublished the marketive trin the mitegral calculus" which was sublished the marketive.

in an extended form some years ago, and is now condensed and simplified in a separate chapter at the end of the work under review, is the most important addition to the teaching material of the integral calculus that has been made for a long time; that chapter alone is worth the price of Prof. Greenhill's book. The plan of drawing the illustrations of the subject from departments of pure and applied mathematics with which the learner may afterwards have to do is also excellent. Finally, there blows through our author's pages that lnimitable freshness which emanates from the man who is familiar with much that is newest and best in his day, who does not merely make extracts from books, but who speaks of things in which he has taken a part. This freshness can only be compared to that agreeable odour which inland people tell us comes from mariners and others who cross the sea from strange lands. Like these same mariners. our author produces from his pockets strange and puzzling curiosities, such as recipiocants, tide predicters, Schwarzian derivatives, Mehler's functions, to delight and to dazzle the learner It is true he tells but little of these things, still, it is pleasant to look at them, and they make us happy under our present toil by leading us to think that we too may one day visit the country where these pretty things are at home amidst their proper sur roundings

Where there is so much to praise we are truly sorry to insinuate the bitter drop of blame, but, much as we love and follow Plato, something must be conceded to truth. In the first place, we think that in this second edition the introduction of heterogenuous illustration has been overdone. The fundamental rules of the infinitesimal calculus are really very few in number, and the practical man's friend would do well to impress that upon him at the outset, instead of scattering these principles through a large volume, and overlaving them with thick masses of disconnected application, to such an extent that poor Mr Practical-Man is in danger of losing his tools among the shavings, or, to use a metaphor which Prof Greenhill's pupils might prefer, of not seeing his guns for smoke Prof Greenhill must recollect that the man that sits down to read his book is not all possible practical menrolled into one, but one poor practical man-say, an engineer-who wants some knowledge of the infinitesimal calculus, and who will find many of the illustrations more indigestible than the principles of the calculus itself Would it not be better for the practical man, as well as for any other man, to have the few leading principles of the calculus set before him with an adequate but moderate amount of illustration of a uniform geometrical kind, and not to be dazed by a flood of oracular statements about soap-bubble films, tide-p edicters, &c , in the course of his initiation? Such digressions are most useful now and then in a lecture ; they serve to give picturesoneness to the discourse, and help to fix the attention of the hearer: but we think that too many of them destroy the usefulness of a text-book, the object of which is quite different from the purpose of a lecture

the hyperbolic functions to systematize the integrations which can be performed by means of the elementary transtendents, has been, as we can testify from experience, a
greathely in elementary teaching. The admirable "chapter in the misergal calculus" which was published separately |
s another matter, of more importance, on which we

would appeal to Prof Greenhill When a man, so able and unconventional as he, writes a book of 455 pages on the infinitesimal calculus, is it too much to expect that he will everywhere give a thorough discussion of its few fundamental principles, that he will rigorously prove what he professes to demonstrate, and honestly point out what he assumes without demonstration? We certainly expact him to root out of the subject every trace of the sham demonstration-that wilv artifice of the coaching and examining days of our dear old alma mater-which used sometimes to be dignified by the name of the "short proof" This used, to be employed when we had on hand the establishment of some proposition which was not universally time (although usually so enunciated), or which had exceptions too tedious to enumerate in an examination. The method was to make a kind of 6r6/15 containing as few words of intelligible English as possible, but a considerable sprinkling of ingeniously constructed but unexplained symbols and formula, so that an examiner of average conscience, suspecting that the truth was not there, might nevertheless, without mental distress, make believe that it was there, and award the coveted marks

We complain that Prof. Greenhill should countenance the slipshod exposition of elementary principles which is the bad feature of so many of our English mathematical text-books. Having started his furrow, he should have ploughed to the end. He may retort that he has adhered to the traditional usage out of consideration for the weakness of the practical man, who abhors sound logic quite as much as his academic brother Cruel consideration for the practical man for what he wants above all is a firm giasp of the furdamental principles of the calculus, he has rarely any use for the analytical house of cards, composed of complicated and curous formulac, which the academic type builds with such zest upon a slipper; foundation

It would take up too much of the columns of NATURE to give all the examples that might be adduced of the laxity we complain of A few must suffice. We are told in § I that the "calculus to be developed is the method of reasoning applicable to variable quantities in a state of continuous change," yet no definition or discussion of "continuity" is given . the word, so far as we can find, does not occur again in the first chapter, although it is the keynote of the subject. "Newton's microscope," for example, is quoted in § 9, as a proof of the theorem Lt(chord arc) = 1, but the essential condition, "in medio curvaturæ continuæ," which makes it a proof (if proof be the word that describes its purpose) is omitted. Although the differential calculus is merely a piece of machinery for calculating, and calculating with limiting values, a limiting value is not defined nor is there any discussion of the algebra of limiting values -- a matter which has puzzled beginners in all ages, and which has stopped many on the threshold of the calculus It is true that we are referred to Hall and Knight's "Algebra," but what we find there is little to the purpose, and certainly could never have been meant by its authors as a foundation for the differential calculus,

In § 16 we are given a quantity of elementary instruction, in the middle of which the trigonometrical functions are inadequately defined; but nothing adequate is said

regarding the sense in which the many-valued functions sin-1x, cos-1x, &c, are continuous and in § 25 the beginner is led by implication to believe that $d(\sin^{-1} i)/dv$ is always + $1/\sqrt{(1-x^2)}$, and $d(\cos^{-1}r)/dr$ always $-1/\sqrt{(1-x^2)}$; although this is not so, and the point is one that is of the greatest importance in the integral calculus, and is a standing rock of offence for learners In \$ 28 we have, reproduced "for the sake of completeness," the time-honoured "short proof" of the existence of the exponential limit, which proof is half the real proof blus a suggestio falsi. If the proper proof (a very simple matter) was thought too much for the reader, then it would have been better simply to tell him the fact, and not to corrupt his intellectual honesty by demanding his assent to a piece of reasoning which is not conclusive 8 31 is no better, what, for instance, does Prof Greenhill mean, after proving that $\exp n = \epsilon^n$, where n is a positive integer, by saving, "and thence generally by induction $\exp x = e^x$ for all values of t" It would scarcely be possible to write down a statement to which more excentions could be taken unless "induction" is a misprint for " assumption "

The chapter on the expansion of functions is not satisfactory. We are first introduced to "a general theorem. called Taylor's theorem, by means of which any function whatever can be expanded [in ascending powers of 1]" Prof Greenhill knows as well as we that there is no such theorem. No theorem ever to be discovered will expand in ascending powers of x, 1/x, 1/1, log 1, or any function Why does our which has x = 0 for a critical point author hide his light from the reader? Does it make the apprehension of Taylor's theorem any easier to enunciate it falsely? We are told in § 114 that "some functions, for instance sec-1x, cannot be expanded in an infinite series in ascending powers of r. because x must be greater than unity, and the expansion by Taylor's or Maclaurin's theorem would be divergent, and the theorem is then said to fail."

"This difficulty will be avoided if we can make the series terminate after a finite number of terms"

We would not advise the practical man to try to overcome the difficulty of expanding sec-ir by the method thus indicated (use of Maclaurin's theorem with the menander), because the result might be that the bond of annity struck in the preface between him and the authory would be broken. All the king's men will not get over this difficulty. Incidentally we are medial in State 1 and 1 and

When so many novelties of less importance are noticed, surely our author night have found a place for a reference to the theorem that puts the expansibility of a function in ascending powers of in histitue position, viii. Cauchy's theorem that every function is so expansible within a certain region surrounding i = 0, provided x = 0 to not a critical value. Considering the great unportance

of the fact, and its close connection with the applications of mathematics to physical problems, some mention might have been made of the importance of the critical points of a function in determining its value. A fall discussion of such things is doubtless impossible in an elementary treatuse; but the reader should at least be warred that what is given regarding the expansion of functions in power-senes is a mere fragment of what is known on the subject. The tendency of Prof. Greenhill's chapter on the expansion of functions creatingly will be to suggest to the mind of a beginner wrong general notions on the subject.

In § 126 we have two proofs given that

$$\partial^2 f(x, y)/\partial x \partial y = \partial^2 f(x, y)/\partial y \partial x$$

both of them insufficient, for the one rests on the assumption that f(x+h,y+k) can always be expanded in an integral h.k-power-series, the other on the assumption that

$$L L_{k=0} L_{\chi(h,k)} = L L_{\chi(h,k)},$$

both of which propositions are liable to exception

In the discussion of single and double integrals, no hint is allowed to reach the reader of the necessity of convergency as a condition of their having any meaning at all, of the precautions that must be observed in differentiating them, or in altering the order of integration. and so on Still, the reader is given a proof of Green's theorem What use this is likely to be to one ignorant of the fundamental character of the convergency and discontinuities of multiple integrals, upon which many of the most important applications of the theorem in question depend, it is not easy to see Too much of the work before us bears, in fact, the character of a hurriedly written précis or syllabus of lectures; witness, for example, the oracular character of §§ 146, 151, 152, &c. Our author makes enormous demands on the intelligence of a beginner if he expects him to follow and understand exposition so elliptical.

One more example of the thing we complain of. In § 18 we are introduced to Founer's sense No proof is given (none was to be expected in an elementary treatise) but it ought to have been stated that there are such conditions. Moreover, the method given for the determination of the coefficients is a mere memorial echonical for recollecting them It has no demonstrative force, because, as the atthor must be very well aware, it is not unconditionally allowable to replace the integral of an infinite sense (even if it be convergent) by the sum of the integrals of its separate terms In order that this may be admissible, the senses must be uniformly convergent.

Seeing that the world is very evil, and not to be mended in a day, we must put up with such things in the ordinary writer of English text-books, who caters for the victims of our manifold examinations. In but in a pillar of mathematical society like Prof Greenhill they are "most tolerable and not to be endured." A work with his name on its back, and the impress of his vigorous personality on its pages, will not remain long in a second edition. If he would be at once the frend of the practical man, and a well-deserver of the mathematical republic, let him, when the third edition is called for, reduce his elementary work to

the compass of the first edition or less, and replace all half demonstrations by honest statements of fact; and let him, meantime, write a larger work, to which he can refer the elementary reader who takes for his motto, G.C.

THE GEOLOGY OF THE COUNTRY ROUND
LIVERPOOL

Geology of the Country around Liverpool. By G. H. Morton, F.G.S Second Edition. (London . Philip and Son, 1891.)

N this work Mr. Morton has entirely re-written the "Geology of the Liverpool District," first published in 1863, by the light of the various discoveries made since that time, and especially of the Geological Survey maps and memoirs. He has succeeded in making a compact and well-printed hand-book, which will be of great service to the students of the local geology. The area described extends to about 20 miles from Liverpool on every side, excepting the sea on the west. The strata which he describes range from the Upper Silurians of the Vale of Clwyd through the Carboniferous, Permian, and Triassic rocks, down to the recent alluvia. To a geologist the chapter relating to the Carboniferous rocks of North Flintshire and the Vale of Clwyd will be of great interest, as it shows the thinning off of the strata as they approach the ancient Carboniferous land of North Wales Carboniferous Limestone, over 3000 feet thick in North Lancashire, is reduced to 1700 feet in North Flint and the Vale of Clwyd, while the Yoredales and Millstone Grits, over 9000 feet thick between Clitheroe and Burnley, are represented by the Cefn-y-Fedw Sandstone, 370 feet. The Lower and Middle Coal-measures, too, of South-West Lancashire, 3180 feet thick, have dwindled down to no more than 1000 feet as they approached the Welsh Silurian Hills It is therefore obvious that the Snowdonian area was dry land while the Carboniferous sea occupied the areas of Lancashire, Derbyshire, and Cheshire, and that it also overlooked the forest-covered morasses, now represented by the coal-seams of the same region in the Upper Carboniferous age. In the table of the rocks (p. 6) Mr Morton gives 300 feet as the thickness of the Millstone Grit in South-West Lancashire. It is probably much more than this, and not much less than 2000 feet Mr. Morton also, we may remark, understates the thickness of the Keuper Marls, which he puts down at 400 feet (p 75) In the Lancashire and Cheshire plain it is 700 + feet, and is estimated by Prof. Hull at 3000 feet

Mr. Morton, in dealing with the deep boring at Bootle, made in 1878, under the advice of the writer of this review, is mistaken in supposing that it was aimed at the water in the Perman Sandstone. It was intended to strike the water in the Lower Bunter Sandstones, and to draw upon the enormous area of water-bearing strata in the Lancashire and Cheshire plain, which have their outlet seawards between Prescot and the estuary of the Dee. It is very likely that the Permans are not represented under Liverpool. We expected to strike the Coal-measures at 100 feet. The sort figure from the geological and the engineering point of view. It proved that the Lower Bunter Sandstones below the top

of the Upper Pebble-beds are more than 1300 feet thick. and that they are highly charged with water. This thickness is altogether without precedent, and Liverpool is to be congratulated upon being built upon so great a thickness of water-hearing Triassic rocks. Mr. Morton, should the work reach another edition, would do well to deal at greater length with the water-supply available from the Triassic strata Mr. Boult has tabulated the well-sections, and all students of the geology of Liverpool would do well to examine his valuable tables

We would call special attention to Mr. Morton's section -unfortunately, the work is not divided into chapterson the origin of the estuary of the Mersey While the river has been draining its present watershed from a period far more remote than the Pleistocene age, he holds that the estuarine portion is comparatively modern, dating probably not further back than post-Roman times It would not, he argues, following Sir James Picton, have been neglected by the Romans, if it had then "presented the copious body of water which it does at the present day" There is no evidence that they did neglect it. The Manchester Ship Canal works have revealed the existence of Roman remains, probably the Veratinum of the anonymous geographer of Rayenna, on the banks of the Mersey close to Warrington, and Mancunium (Manchester) is on one of its tributaries. They used it, as they used all the rivers of Britain, for their own ends Deva (Chester), the great port, and military centre of the north-west, was not far off, and amply sufficient for the western trade at a time when there were no ports in Ireland. The commercial importance of the Mersey is solely due to the trade with the New World There was no reason why the Romans should have paid special attention to the estuary of the Mersey, and it was outside the system of their roads Nor can the date, 1279, of the great inroad of the sea over the Stanlow Marshes, by which the Abbey of Stanlow, built upon a rock only 28; feet above OD, lost much of its land, be taken as evidence of the modern formation of the estuary. The river swings to and fro at the present time, depositing silt here, and carrying away its banks there In our opinion, therefore, the post-Roman origin of the Mersey is not proved It is still less likely that it is the result of a local submergence, which has not affected Warrington and the adjacent area of Chester As the evidence stands, the date of the estuary of the Mersey belongs to the same remote prehistoric period as the estuary of the Thames and of the Humber-certainly after the time of the boulder clays, and probably long before there were any written records in Britain All three are later than the time of the submarine forest which, on the west of Britain. afforded shelter, not merely to our Neolithic ancestors, but to their domestic animals, such as the small shorthorn (Bos longsfrons), the goat, and the dog.

W BOYD DAWKINS

OUR BOOK SHELF.

Les Microbes, les Ferments, et ses Moistssures. Par le Dr. E L. Trouessart. Deuxième Edition. Bibliothèque Scientifique Internationale. (Paris, 1891.)

NO. 1130, VOL. 44]

first edition, give an excellent though short account of the morphology and physiology of fungi and of yeast Although chapter iii. (on bacteria) is enlarged, we do not think it is sufficiently up to date; thus, for instance, on pp 74 and 75, the author questions the existence of true flagella in bacteria, and states that their motility is essentially different from that of flagellate infusoria Again, in the section in which putrid decomposition is described no mention is made of the entire tribe of Proteus, the essential microbe of putrefaction.

Chapters iv and v. (pathogenic bacteria) are considerably enlarged, both as to text and illustrations The rest of the book, chapters vi -ix, does not differ in any essential

respect from its predecessor

On the whole, the book is very commendable as a concise text-book, well written and copiously illustrated, and as such deserves a high place in the literature of the subject

Botanical Wall Diagrams. Size 312 inches by 24 inches, printed in colours (London Society for Promoting Christian Knowledge, 1891)

A HERST instalment of six of these diagrams is now pub lished The plants illustrated so far are common elder, deadly nightshade, scarlet runner, hop, Virginia tobacco, and wild camomile We do not know on what principle the selection has been made. It is rather a pity that, out of so small a number, two (deadly nightshade and tobacco) belong to the same natural order, and show no very essential structural differences we hope that all the unportant orders will be re-presented. The drawings (executed by Engleder, of Munich) are quite artistic, and the colouring excellent The diagrams are thus very pleasing as pictures, and at the same time the botanical details are correct

If the series is continued as well as it has been begin, it ought to be a very useful help in the elementary systematic teaching of botany I) H S

Chambers's Encyclopædia New Edition Vol VII. (London and Edinburgh W. and R. Chambers, Vol. VII. Limited, 1891)

No one who has had occasion to refer to the new edition of Chambers's " Encyclopædia" can have failed to appreciate the care and ability with which it is being prepared The editor has been fortunate enough to secure the cooperation of many eminent writers, and the information given in the various articles, speaking generally, is well up to date and presented in the way most likely to be convenient for students. We are here concerned only with the papers on scientific subjects, and these, in the present as in the preceding volumes, are in every way worthy of the place which has been assigned to them in the scheme of the work as a whole Prof. P G Tait contributes a short but masterly paper on matter, and Dr. Buchan gives a clear and interesting account of The essential facts about the Mediterra meteorology ncan are compressed into very small space by Dr John Murray, who also writes on the Pacific Prof James Geikie deals with mountains and palæontology, and Dr Alfred Daniell has a good popular article on optics, devoted mainly to the history of optical science. In an article on man, Mr J. Arthur Thomson states very well some of the problems relating to human characteristics, the origin or descent of man, and the antiquity of the race: and the same writer sketches the career of Pasteur. and treats of mammals and parasites Municry forms the subject of an excellent paper by Mr. E B Poulton Of course, no subject is treated exhaustively, but the TRIS is not only an enlargement but a distinct improvement on the first edition. Chapters i and ii., as in the justification of the purposes for which an encyclopedia is

Glimbses of Nature By Andrew Wilson. (London Chatto and Windus, 1801)

MR WILSON does not profess to present in this book anything strictly new, or to give a full account of the various subjects with which he deals. Nevertheless, the volume may be of considerable value, for on all the groups of facts in which he is interested he is able to discourse brightly and pleasantly, and many of his short papers are well calculated to excite in the minds of intelligent readers a desire for more ample knowledge.
The papers are reprinted from the Illustrated London

LETTERS TO THE EDITOR.

[The Editor does not hold himself sesponsible for opinions ex-pressed by his correspondents. Nisher can he undestake to return, or to conseppend with the winters of repeted manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications]

The Fusing and Boiling Points of Compounds.

I HEREWITH send you the translation of a note just presented for me by M. Berthelot to the Parts Academy, as you may see in the ContMcs renduc. I have added two illustrations and a few words in italics St Louis, May 8. GUSTAVUS HINRICHS

Statement of the General Law determining the Fusing and Begling Points of any Compound under any Pressure, as Simple Function of the Chemical Constitution of the same by Dr. Gustawa Himrichs

The atomic form of normal lineary compounds, such as the paraffins, alcohols, acids, is very nearly prismatic. All other acrial compounds may be referred to these, either as isometics or

The boiling point f of a prismatic compound consists of two distinct functions, namely-

where
$$t = y_1 + y_2$$
 , , , (1)
 $y_1 = I_1(\log a + \log a_1)$, , (2)
and $y_2 = I_2(\log a_2 + \log a)^2$, , . . (3)

The symbols a_1 and a_2 represent certain definite values of the atomic weight a of the compound, while k_1 and k_2 are constants.

constants. For every value of the atomic weight a greater than a_1 the formula (1) is limited to $c = y_0$, which, according to (2), represents the straight line which I call the logarithmic limit, the ordinate being the boiling-point t, the alsociate x, the logarithm of the atomic weight $x = \log a$. For values of a less than the above limit a_p , the parabolic ordinate y_n determined by (3), must be added $t > y_p$. according to (1), in order to obtain the boiling-point.

bosing-posm.
Accordingly, the boiling point curve of any homologous series of prismatic atom-form consists of a parabolic arc (3), tangent to the logarithmic limit (3), 43 the point determined by a = a. The constant A, determines the inclination of the logarithmic limit, and A, may be called the parameter of the parabolic

Inarch.
All compounds derivable by terminal substitution from normal paraflats have a common logarithmic limit, determined by paraflats have a common logarithmic limit, determined by Every pubriculal homologous series of this great faithful of compounds a complexity determined by the special value of the companies, and \$\phi_p\$ for example, the charty-five normal reason of the properties tances are the head of the corresponding homologous series—that ii, H for the paraffins, H_0N for momentum, ii.

If now the co-ordinate $s = \log p$, where p is the pressure of



as substitution products The boiling and fusing points of these latter are obtained from those of the former according to laws latter are obtained from those of the former according to laws and processe pobls hed by me a vocat ventry years ago, partly in my. Principles, of Sulecular Mechanisms, partly and processe position of the processing of the done in an Assessation by the Advancement of Science for 1868. It remains, therefore, only to show how those fundamental points are determined for generated positions. pounds.

the saturated vapours, be laid off on the third rectangular axis the salarmen vapours, be that off on the third rectangular axis the above given values 1 elong to the plane XY determined by $\rho=760$ mm. For the pressure $\rho=15$ mm, the logarithmic limit is determined by $\lambda_1=517^{\circ}0$, and $\alpha_2=113.81$. If will be noticed that its inclination towards the X axis is less, and that it intersects the same at a greater distance from the origin. The logarithmic limit surface, generated by the log-authmic limits for all pressures, is a hyperbolic paraboloid, fully determined by the above two lines for 15 and 760 mm pressure. For any liquid, the absolute temperature T of the boiling under a pressure of p atmospheres is determined by the same general law slightly specialized as follows —

where
$$T = Y_1 + Y_2 \dots \dots (4)$$

 $Y_1 = K_1[1^*4 + \log p] \dots (5)$
and $Y_1 = K_2[\log \pi - \log p]^1 \dots (6)$

The logarithmic limits of all liquids astensed in the same absolute zero point determined by T=0=0=-27; C and $\log\rho=-1/4$. For each individual liquid this limit extends upwards to the critical point of the liquid, $\rho=\pi$ and $T=\theta$. For many liquids the critical point can be theoretically calculated, as well as the value of the parameter. It is understood

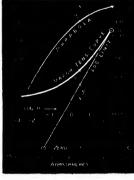


Fig 2.

that the parabolic curve is tangent to the logarithmic limit at i

It hardly needs to be said that the tension of dissociation, and even the solubility of solids, are subject to the same general law The fusing points are obtained by simply changing the sign

re obtained by simply changing the
$$l = r_1 - r_2$$
 (

so that the parabolic curve will be placed below the logarithmic

One of the most remarkable results of this research is the mechanical determination of the true position of the carbon atoms in organic serials, and the complete explanation of the difference in issuing point between compounds containing an even and old number of carbon atoms.

It should also be understood that the change in furing point produced by change in pressure is expressed by the same general

Name. Putting $\log a = v$, $\log f = z$, and $\log a = \xi$, $\log w = \zeta$, the formulæ (1) to (7) will become

These formulæ strikingly show the simplicity of the laws attacd, and also determine the surfaces formed by the coordinates x, t, and y in general.

In subsequent notes special topics covered by this general law will be taken up, and the complete concordance of the law with the results of observations will be shown.

Porpoises in African Rivers.

In reference to Mr Schäef's letter in NATURE of June II pr 124, the following may be interesting to your readers — The skull of a Delphionod Cetacean from Cameroon has tactly come and to my hands, through the kundress of Prof following information concerning if The animal to which it belonged was coaght in Knegachit By, after very heavy rains, and was being devoured by sharks. The contents of the stometon consisted of graw, weeki, and mangrove fruits. Note of the shark of the content of the stometon of th

Jam preparing for publication a detailed description of the Sull, and must here confine myself to emarking that, though the animal belongs to the genus Sulain, it differs in several secretal points from all the species of this genus binetro idesected properties of the second properties of the twenty-seven teeth on each side in each juw. Their form, in that they are no pointed, but word own, indicate, as is so do the contents of the stomach, that the animal is herbivorous. It would be supported to the summer of the summer of the word known that other Souliai live in rivers.

Jena, June 20 WHITE KUKENTHAI

PHYSICAL SCIENCE FOR ARTISTS.

I HINK it right that I should begin by explaining how it is that I am here to-day, to lecture to you on a subject which touches art as well as science. It happens in this wise. Some years ago, while studying a certain branch of optics, it became important for me to try to summer and its student of the property of the

My friend, and your friend, Dr Russell, happens to know this little bit of my experience, and hence it has less is that he requested me to come down to-day to say a few words to you, his plea being that this College is one of the very few institutions of its kind in the world where there is a studio and a physical laboratory side by side.

That, then, is the reason I am here, and what I want to impress upon you to-day is that the highest art can only be produced by those who associate the study of physical science with the study of art, and that therefore the possible producers of the highest art can only be looked for in such an institution as this if training of any kind has anything to do with it.

*A Letture delivered at Bedford College, by J. Norm in Lockyon, F.R. S. on June to, 1991

I think that the general conditions of art training as they exist at present absolutely bar any sufficient know-ledge of the laws and conditions of natural phenomena

on the part of art students

The best art of the time has always been on a level with the best science of the time, and if it had not happened that the first schools and the first Universities clustered round medical schools and schools of anatomy. I do not think that so much attention would be given to-day to anatomical science to the exclusion of all other branches.

You see, then, it comes to this. It is conceded by the art world that in a certain direction the phenomena of Nature require to be studied, otherwise that tremendously exuberant literature on Anatomy for Artists would not have been written, and more than half of the time of students of art would be spent in studying something else rather than those things which they do study
It is on that ground that I would venture to say that in

other institutions, as in this one, the study of physical science should be added to the other branches already

recognized by the art world

l am not an artist I am not an art critic I am almost unacquainted with the language usually employed by those who write on art subjects. I shall not deal with opinions, the algebraical sum of which in relation to the qualities of any one picture I have often noticed is zero; but what I shall try to do is to stick as closely as I can to the region of fact, and endeavour to show you, by two or three individual instances, how a student who wishes to become a great artist- as some of you no doubt dowill find his or her ambition more likely to be realized if the study of physical science be combined with that of "Art as she is taught" to day.

In looking at the Academy Catalogue this year one finds the motto, "La mission de l'art n'est pas de copier la nature, mais de l'expiriner," and this is a true motto But let us analyre it a little To "express" suggests a language; a language suggests a grammar, if it is to be perfect, satisfying But what can this grammar be, in the case we are considering, but the laws underlying the phenomena the "expression" of which, in his own language, constitutes the life-work of the artist Should he be content to show himself a bumpkin? Are solecisms to be pardoned in his expressions because, so far, scientific training and thought are so limited? Is he justified in relying upon the ignorance of mankind, and, if so, is the highest art always to remain divorced from the highest knowledge?

Now it so happens that the branch of physical science which is above all things the thing to be studied by artists, is the branch of it which is already familiar to you—namely, optics. There could be no art without light; no artists without light, and the whole work of an artist, from the beginning to the end of his life, is to deal with light Now we live in a world of white light. We might live in a blue world, or a green world, and then the condition of things would be different, but we can, in our laboratory, make our world red or green for the moment, but some-times, indeed, when we do not seek to make this experiment, we find the world changed for us by the means which we employ for producing artificial lights, such as candles, gas, or the electric light, since in these, colours are not blended in the same way as in a sunbeam

We thus come to the question of the radiation of light, and the way in which this light, whatever its quality, is re-flected by natural objects, it is by this reflection that we see them Everything that an artist paints which is white, is painted white by him for the simple reason that it reflects sunlight complete. It is perfectly clear that any reflecting surface can only reflect the light which at rehave red walls and green trees; the direction of the light is not changed, except in the way of reflection, and you are already acquainted with the imperative law of optics -that when light falls upon a body and is reflected, the

angle of reflection is equal to the angle of incidence.

To us this drastic law is of the very highest interest. We can apply it to art in a great many ways, but I will only take two very simple ones. Oftentimes it is our fortune to be in the country by the side of a river, or at the seaside. In both cases we see things reflected in water, and at first sight it would seem that here the artist ought to find perfectly free scope, but the worst of it is that, though he has free scope, sometimes his on it is that, though he has free scope, sometimes his picture becomes very unpleasant to people who are acquainted with the law! I have stated 1 find here some diagrams, prepared by the kindness of some of our friends, which will show you the intimate connection between art and science in this direction. In the pictures which you will see in the Royal Academy and the New Gallery, I fancy you will see some which, if you care to study them from this point of view, will be found not to agree with the law

In the diagrams we have a surface of water and observers at the top and bottom of a cliff. We have on the other side of this surface of water a tree Now, what anyone would do who disdains to "copy" Nature, and who paints without thinking, is this he would paint what he saw on the bank, and then turn it upside down and paint it again But you see that will not do, because the conditions are as you see them here. The higher spectator, No 1, the angles of incidence and reflection being equal, although he can see the upper part of the tree and part of the trunk, will not be able to see it all completely reflected in the water. You see that the lower part of the tree cannot be seen in the reflection, because any light reflected by it first to the water and then to the eye is really cut off from the eye of the spectator by the bank; if you greatly vary your distance from the other side of the water, you will find the reflection as represented in the other diagram Now, to anyone who has studied optics, if such a matter as this is represented wrongly in a picture, it becomes an intolerable nuisance, and when you go away you feel sorry that the artist did not do justice to what he wished to represent A good example of truth to Nature in this respect is to be seen at the German Exhibition-No. 205-in one of the landscapes, which I saw last night, it is a beautiful instance of careful study, and is absolutely true in this respect. The artist has shown liow a lutely true in this respect mountain side, with high lights upon it, reflected on the surface of a lake, appears very different in the reflection, in consequence of an intervening elevation near the edge of the water When you have thought out the difference of the appearances on the lake and on the hillside, you will appreciate the truth and skill of the artist enormously

Another serious fault arising from the neglect of this same law is to be found in very many pictures in which we get the reflection of the sun or moon in water

Obviously, if the water is disturbed, the reflection upon the water must depend upon the direction of the disturbance I need not say more than that to you You will quite understand what I mean, but if you look at the pictures in the Royal Academy this year—Nos. 677, 1071, and 1155—you can see how very admirably this reflection can be rendered; and if you look at 165 and think the conditions out, you will wonder how the artist should trouble to paint something that is absolutely opposed to the physical law.

opposed to the physical law.

You know that, in those instances where you get a
natural reflection, if the light source be beyond the object
which reflects the light, the nearer it is in a line with it
the more light will be reflected. You see that that rule relates to almost every landscape or seascape that is painted, for the reason that our air is filled with particles which reflect light. If it were not so, our atmosphere would be absolutely black.

It therefore follows that the light of the sky must increase in intensity as the sun or moon is approachedthat is to say, in a sun-setting or moon-setting, if you paint an unbroken sky, there must be an increase of intensity towards the light source. I am almost ashamed to make such a statement, because it is so obvious to you as students of science, but to the artist who is not a very service observer, why should it artible him! The fact strict observer, why should it artible him! The fact you study the pictures Nos. 650, 580, 1444, in the Royal Academy, and No. 39 in the New Gallery, you will find there indications of a neglect of this law. Now the sky is far more luminous than it ought to be by the light indicated by the landscape. Again, the setting sun is not so bright as the clouds which it is supposed to fluminate, too indicated, and, if anything, the sky is rather less luminous where the sun is than further away!

A good rule, and one which a student of physical science would be ceitain to act upon with considerable care, would be never to show anything as reflected which

An interesting example of this kind was exhitted in the Academy some years ago! Is so happened that a French man of science wrote a book on physical phenomen, beautifully illustrated. Among the illustrations was a coloured copy of a photograph of a soap bubble was bordy in the Collège de France, in which the photograph was taken, was, like yours, very well lighted by many windows, and the soap bubble was blown in the middle of it. A translation of this book appeared in English, and the illustrations were reproduced.

An artist had a most excellent idea. He thought he would paint a picture of a garden, which he did admirably. The foreground looked bare, so he thought he would put children playing in it. It next struck him, with the properties of the picture of

Then, again, an the matter of reflection, it would not be right that I should fall to remind you that, besides things terrestrial, we have the moon, which rules the inght, and rules the night because it reflects the smulght to us. Now, in a little talk like this I must not take up much time with astronomy, but it is fortunate that books on astronomy can be got for 6d or is which will tell us, which we made consider in the present connection. The moon is lighted by the sun. The sun can only light one half at a time. If we are on the side of the moon which is lighted by the sun, we must see the complete lighted half which we call a full moon. If we see a full moon, we must have our back to the sun. If we see a full moon, we must have our back to the sun. When the position of the moon with reference to the earth is such that we can that the can the sun is lighted up.

But none of these things are so in art. Last year a picture in the Academy was absolutely disfigured by the dark part of the moon being turned to the sim. Surely twin sort worth the artist's while to paint a moon if he tidd not know how to do it. But the moon has been the properties of the similar to see it the moon was right. I went and saw the picture, and had to say that the moon was saw the picture, and had to say that the moon was saw the picture, and had to say that the moon was saw the picture, and the similar that the picture was some similar to the similar to t

must be full. My friend said to me he knew this, and that as a matter of fact the arist had painted a full mono to start with, but he had altered it because it "destroyed the balance of his picture." That you see was where art came in. And then he added to stone the stone of the picture of the picture, and that stone it stone

I am sure that the students of this College will know that such things as these are to be avoided, even if there were difficulties caused by the non-existence of a book on astronomy. No artist need paint a moon in a picture

if he be too ignorant to paint it properly

Everything that you paint in a picture, which you paint because it reflects light, should be painted its proper size in relation to the other objects. It seems, however, that the moment a body which reflects light does not happen to be on the surface of the earth, you may, in art, make it as large as you please. I do not think that the monn's distance from the earth gives us any right to treat it in this way.

An eminent American astronomer some years ago looked at the pictures in the New York galleries from this point of view. The moon subtends a certain angle Everything else in a picture can be expressed in this way the moment you put a moon into! This astronomer took the trouble to get out, a statistical table of the did the picture of the country of the picture of the country of the picture of the country of the picture of t

Next, permit me to xay a few words on another point, in order to show that the student of art will delight more and more in his work as he or she knows more and more of refraction can be divided into deviation and dispersion. The phenomena of deviation tack dispersion. The phenomena of deviation teach us that when a heam of light, whatever its colour, passes out of one medium into another its course is changed. An experiment, which is easily performed and which is more a home-experiment to look over the edge in such a direction that the coin is just invisible then fill it with water, the coin appears Another experiment is to insert a straight body, such as a pencil, into this bowl of water it appears to be broken; a pencil, which is bowl of water it appears to be broken; really is if you look at 1004, you will find that this deviation has been made to act the wrong way.

It is rather a bad thing to attempt to paint a nymph partly in and partly out of clear water, because her body, if the picture be truly painted, would follow suit with the pencil

Passing from deviation to dispersion we come to ranbows. You have learned, and perhaps seen demonstrated by experiment, that we deal with a beam of white light coming from the sun and refracted at the front surface of a ran-drop. It is next reflected and again refracted down to the eye, so that the eye sees a bow, with all the spectrum colours due to the dispersion. If the light be strong enough, we get what is called a supplementary bow, and, in consequence of internal reflections, the two reds are brought together.

The point is that in this dispersion, brought about by the rain-drops, the effect is produced in a plane passing through the sun, your eye, and the rain-drop; your eye being in the centre, so that if you see a rainbow at all, you must have your back to the sun. The bow is always circular, and high or low according to the height of the

sun. Those are, of course, conclusions which a very restricted study of physical science will make perfect clear: why you get the two reds together when two bows are evisible; why the blue is made, and the red outside the single bow, also follows from a demonstration study to the study of the study of the study of the from a book. The main point is that a rambow is produced by a physical cause, so that, if you once grasp the idea of the cause of a rambow, its whole anatomy will remain for ever with you.

"It is qu'ils impossible for you to see a rambow in prosective, or projected on the ky as an ellipse. That will be quite clear, I think. Still, both these are recogniced arrobects. I am solry to hay that in this year's Academy there is one case in which you will find that the fundamental condition of having your back to the hot. 35 a most resultant to the property of the think of the control of the property of the control of the property of t

(To be continued)

THE FARADAY CENTENARY

ON Wednesday, June 17, at the Royal Institution, Lord Rayleigh delivered a lecture in connection with the hundredth anniversary of Faraday's birth. The Prince of Wales presided.

Lord Rayleigh said that the man whose name and work they were celebrating was identified in a remarkable degree with the history of that Institution if they could not take credit for his birth, in other respects they could hardly claim too much. During a connection of fifty-four years, Faraday found there his opportunity, and for a large part of the time his home. The simple story of his life must be known to most who heard him. Fired by contact with the genus. of Davy, he volunteered his services in the laboratory of the Institution. Davy, struck with the enthusiasm of the youth, gave him the desired opportunity, and, as had been said, secured in Faraday not the least of his discoveries The early promise was indeed amply fulfilled, and for a long period of years by his discoveries in chemistry and electricity Faraday maintained the renown of the Royal Institution and the honour of England in the eye of the civilized world. He should not attempt in the time at his disposal to trace in any detail the steps of that wonderful career. The task had already been performed by able hands. In their own Proceedings they had a vivid sketch from the pen of one whose absence that day was a matter of lively regret. Dr. Tyndall was a personal friend, had seen Faraday at work, had enjoyed opportunities of watching the action of his mind in face of a new idea. All that he could aim at was to recall, in a fragmentary manner, some of Faraday's great achieve-ments, and if possible to estimate the position they held in contemporary science Whether they had regard to fundamental scientific

monetar to y man regent to indicate the summer of the control of t

that Faraday's discoveries were so fundamental as to have become familiar to all serious students of physics. The first experiment required them to establish in one

coil of copper wire an electric current by completing the communication with a suitable battery; that was called the primary circuit, and Faraday's discovery was this:
That at the moment of the starting or stopping of the
primary current in a neighbouring circuit, in the ordinary sense of the words, then completely detached, there was a tendency to induce a current. He had said that those two circuits were perfectly distinct, and they were distinct in the sense that there was no communication between them, but, of course, the importance of conducting the experiment resided in this—that it proved that in some sense the circuits were not distinct; that an electric current circulating in one does produce an effect in the other, which is propagated across a perfectly blank space occupied by air, and which might equally well have been occupied by vacuum. It might appear that that was a very simple and easy experiment, and of course it was so in a modern laboratory, but it was otherwise at the time when Faraday first made it With all his skill, Faraday did not light upon truth without delay and difficulty. One of Faraday's biographers thus wrote—"In December 1824, he had attempted to obtain an electric current by means of a magnet, and on three occasions he had made elaborate and unsuccessful attempts to produce a current in one wire by means of a current in another wire, or by a magnet He still percurrent in another wire, or by a magnet He still per-severed, and on August 29, 1831—that is to say, nearly seven years after his first attempts-he obtained the first evidence that an electric current induced another in a different circuit" On September 23rd, he writes to a a different circuit." On September 23rd, he writes to a friend. R Phillips "I am busy just now again with electro-magnetism, and think I have got hold of a good thing, but cannot say, it may be a weed instead of a fish that, after all my labour, I at last haul up." We now know that it was a very big fish indeed Lord Rayleigh proceeded to say that he now proposed to illustrate the mechanics of



the question of the induced current by means of a model (see figure), the first idea of which was due to Maxwall. The one actually employed was a combination known as Huygen's gear, invaried by hum in connection with the winding of clocks. Two similar pulleys, A, B, turn upon a piece of round steel fixed horizontally. Over these is

hung an endless chord, and the two bights carry similar pendant pulleys, C, D, from which again hang weights, E, F. The weight of the cord being negligible, the sys-tem is devoid of potential energy; that is, it will balance, whatever may be the vertical distance between C and D. Since either pulley, A, B, may turn independently of the other, the system is capable of two independent motions.

If A, B turn in the same direction and with the same velocity one of the pendant pulleys, C, D, rises, and the other falls. If, on the other hand, the motions of A, B are equal and opposite, the axes of the pendant pulleys and the attached weights remain at rest. In the electri-cal analogue the rotatory velocity of A corresponds to a current in a primary circuit, that of B to a current in a secondary. If, when all is at rest, the rotation of A be suddenly started, by force applied at the handle or otherwise, the inertia of the masses E, F opposes their sudden provement, and the consequence is that the pulley B turns backwards, s. e. in the opposite direction to the rotation imposed upon A. This is the current induced in a secondary circuit when an electromotive force begins to act in the primary In like manner, if A, having been for some time in uniform movement, suddenly stops, Il enters into motion in the direction of the former movement of A. This is the secondary current on the break of the current in the primary circuit It might perhaps be supposed by some that the model was a kind of trick Nothing could be further from the truth. The analogy of the two that precisely the same argument and precisely the same mathematical equations proved that the model and the electric currents behaved in the way in which they had seen them behave in the experiment. That might be considered to be a considerable triumph of the modern dynamical method of including under the same head phenomena the details of which might be so different as in this case. If they had a current which alternately stopped and started, and so on, for any length of time, they, as it were, produced in a permanent manner some of the phenomena of electrical induction, and if it were done with sufficient rapidity it would be evident that something would be going on in the primary and in the secondary circuit The particular apparatus by which he proposed to illustrate those effects of the alternating current was devised by a skilful American elec-trician, Prof Elihu Thompson, and he had no doubt it would be new to many. The alternating current was led into the electro-magnet by a suitable lead; if another electric circuit, to be called the secondary circuit, was held in the neighbourhood of that, currents would be induced and might be made manifest by suitable means. Such a secondary circuit he held in his hand, and it was connected with a small electric glow lamp. If a current of sufficient intensity were induced in that secondary of sufficient intensity were induced in that secondary circuit it would pass through the lamp, which would be rendered incandescent [illustrating] It was perfectly clear there was no conjuring there, the incandescent lamp brightened up. One of the first questions which presented itself was, what would be the effect of putting something between Experimenting with a glass plate, the properties of the present copper plate the lamp went completely out, showing that the copper plate was an absolute screen to the effect, whatever it might be Experiments of that kind, of course in a much less developed and striking form, were made by Faraday himself, and must be reckoned amongst some of his greatest discoveries

Before going further, he might remark on what strong evidence they got in that way of the fact that the propagation of the electric energy which, having its source in the dynamo downstairs, eventually illuminated that inthe lamp, was not merely along the wires, but was capable of bridging over and passing across a space free from all conducting material, and which might be are; glass, or;

equally well, vacuum Another kindred effect of a striking nature, devised by Prof. Elibi Thomson, consisted in the repulsave action which occurred between the primary current circulating around a magnet and the current induced in a single hoop of aluminum wire. Illustrating this by experiment, he showed that the repulsave was to be a single for the property of the

About the time the experiments of which he had been speaking were made, Faraday evidently feit un-easiness as to the soundness of the views about electricity held by his contemporaries, and to some extent shared by himself, and he made elaborate experiments to remove all doubt from his mind. He re-proved the complete identity of the electricity of lightning and of the electricity of the by words which might convey a meaning beyond that which facts justified. Much use was made of the term "poles" of the galvanic battery Faraday was farad of the meaning which might be attiched to the word pole," and he introduced a word since generally substituted, "electrode," which meant nothing more than the way or path by which the electricity was led in the way or path by which the electricity was led in dangerous, as meaning more than they really knew about the nature of electricity, and was remarked by Maxwell, Faraday succeeded in banishing the term "electric fluid" to the region of newspaper paragraphs.

Diamagnetism was a subject upon which Faraday worked, but it would take him too long to go into that subject, though he must say a word or two found that whereas a ball of iron or nickel or cobalt. when placed near a magnet or combination of magnets, would be attracted to the place where the magnetic force was the greatest, the contrary occurred if for the iron was substituted a corresponding mass of bismuth or of many other substances. The experiments in diamagnetism were of a microscopic character, but he would like to illustrate one position of Faraday's, developed years after-wards by Sir Wm Thomson, and illustrated by him in many beautiful experiments, only one of which he now many occurring experiments, only one of which ne now proposed to bring before them. Supposing they had two magnetic poles, a north pole and a south pole, with an iron ball between them, free to move along a perpendicular line, then, according to the rule he had stated, the iron ball would seek an intermediate position, the place at which the magnetic force was the greatest. Consequently, if the iron ball be given such a position, they would find it tended with considerable force to a central position of equilibrium; but if, instead of using opposite poles, they used two north poles, they would find that the iron ball did not tend to the central position, because that was not the position in which the magnetic force was the greatest. At that position there was no magnetic force, for the one pole completely neutralized the action of the other. The greatest force would be a little way out, and that, according to Faraday's observations, systematized and expressed in the form of mathematical law by Sir Win Thomson, was where the ball would go This was illustrated by experiment.]

The next discovery of Faraday to which he proposed to call attention was one of immense significance from a scientific point of view, the consequences of which were not even yet fully understood or developed. He referred to the magnetization of a ray of light, or what was called

in more usual parlance the rotation of the plane of polarisation under the action of magnetic force. It would be hopeless to attempt to explain all the preliminaries of the experiment to those who had not given some attention to those subjects before, and he could only attempt it in to those subjects before, and he could only attempt it in direction perpendicular to that of the ray of light By experiment he showed that the polarization which was suitable to pass the first obstacle was not suitable to pass the stored, but if by means of any mechanism they turn round the vibration, they would then give it an opportunity of passing the second, but if by means come of any mechanism they turn round the vibration, they would then give it and turn round the vibration, they would then give it and what was involved in Faraday's discovery [Experiment]. As he had as also, the full agenticance of the experiment however, was contained in the observation of Sir William Thomson, that the rotation of the plane of polarization proved that something in the nature of rotation must be going on within the medium when subjected to the magnetism gforce, but the precise nature of the rotation not be known for some time to come.

When first considering what to bring before them he hought, perhaps, he might include some of Faraday's acoustical experiments, which were of great interest, though they did not attract so much attention as his fundamental electrical discoveries. He would only allude to one point which, as far as he knew, had never been noticed, but which Faraday recorded in his acoustical papers. "If during a strong steady wind, a smooth flat sandy shore, with enough water on it, either from the hought of the strong which was not been sometimed to the consideration of the strong which is not to form wases, he observed in a place where the wind is not broken by pits or stones, stationary undulations will be seen over the whole of the wet surface

... These are not waves of the ordinary kind, they are (and this is the remarkable point) accurately parallel to the course of the wind. When he first read this statement, many years ago, he was a intiel doubtful as to make the possibility of the papears to the statement of Paradoy words. He knew, the appearent to the parallel words the possibility of waves of that kind being generated under the action of the wind, and it was, therefore, with some curonst that two or this eyes ago, at a French watering-place, he went out at low tide, on a suitable day watering-place, he went out at low tide, on a suitable flay words and the statement of the could be considered to the statement of the possibility of the poss

Many matters of minor theoretic interest were deast with by Faraday, and reprinted by him in his collected with by Faraday, and reprinted by him in his collected lamentable accident which occurred owing to the breaking of a parafini namp. Faraday called attention to the fact, though he did not suppose he was the first to notice it, that, by a preliminary preparation of the lungs by a number of deep inspirations and expirations, it was possible so to acreate the blood as to allow of holding the breash for a acreate the blood as to allow of holding the overship of a scratch that the collection of the control of the collection of the col

The question had often been discussed as to what would have been the effect upon Faraday's career of discovery had he been subjected in early life to mathematical training. The first thing that occurred to him about that, after reading Faraday's works, was that one would not wish him to be anything different from what he was. If the question must be discussed, he supposed they would have to admit that he would have been saved much wasted labour, and would have been better en rapport with his scientific contemporaries if he had had elementary mathematical instruction. But mathematical training and mathematical capacity were two different things, and it did not at all follow that Faraday had not a mathematical mind Indeed, some of the highest authorities had held (and there could be no higher authority on the subject than Maxwell) that his mind was essentially mathematical in its qualities, although they must admit it was not developed in a mathematical direction. With these words of Maxwell he would conclude. "The way in which With these words Faraday made use of his idea of lines of force in coordinating the phenomena of electric induction shows him to have been a mathematician of high order, and one from whom the mathematicians of the future may derive valuable and fertile methods"

THE ROYAL NAVAL EXHIBITION.

THE Naval L-vhbition, now being held at Chelea, is distinctly a popular show. The management—recogning that the first duty of an Exhibition is not to show a pecuniary deficit—line wheely decided to follow the lead given by Sir Philip Cunliffs Owen, and has perpendicular to the properties of the properties of the properties of the properties of a kind known to salors as "improngs". The end justifies the means. Not only does the Committee of distinguished Admirals labour to supply Londoners with a cheap and innocent albour to supply Londoners with a cheap and innocent description of the properties of

The Exhibition appears to be divided into about half-acores sections, each under the direction of a committee Of these the "Entertainments" and "Refreshments" Committees appears to be the one which has made the most mittee appears to be the one which has made the most logical sequence. In the Septings Callery here is a collection of models of warships illustrating the progress of naval architecture, from the Great Harry of down to the very latest design of armour-chad battleship. The model of the Great Harry is of very doubtful authenticity, and is of modern construction, having been made to shape a ceast. No historical collection of British warships would, however, be even approximately complete without a representation of this vessel. Charnock, our great sauthority on the subject, has styled her "the presentation of this vessel. Charnock, our great sauthority on the subject, has styled her "the presentation of this vessel. Charnock, our great sauthority on the subject, has styled her "the could be, otherwise than by the and of oars, taken to the quarter from which the wind was blowing. It must have seemed a great feat in those days—little less than necro-many. Portunately for the timed intellecture as a more many. Portunately for the timed intellects of our rounded bulls, high topsides, and currously rigged craft rounded bulls, high topsides, and currously rigged craft could not have sailed more than a point or two to wind-

ward. Still, it was the Great Harry, or one of her comtemporaries, by means of which his new feature in seamanship was inaugurated; a feature by which the great middle period in the world's history of naval warfare was created, and which enabled the sailors of those times to make a dintrict advance upon the lessons taught them by their inand Standinavians. It would have been well if we had improved on our predecessors in other nautucal matters as well; and we then should not have had, even in the present century, our shipurpights attaching lead sheathing to ships' bottoms with iron mails. The Romans used and of their weeken they feat covered the under-vater

There are but three models of seventeenth-century ships in the Exhibition, but one of these is a vessel that forcibly illustrates, by contrast, the mutability of the present age. The Royal William was designed by the first great naval architect, Phineas Pett—whose name might almost more appropriately have been given to the Models Gallery than that of Seppings -and was built at Moders Callety from that of Seppings—and was outlety from that of Seppings—and was outlet Catalam in 1670. She was onginally a three decker, carrying one hundred guns, but in 1757 she was cut down to a ship of 8 guns, and was finally broken up in 1813—A fact duly recorded by the present Director of Naval Construction, Mr. W Hw White, in his delightful lecture on "Modern War Ships," delivered a few years ago at the Manson House "The Royal Wildhum must not, however, be taken as an example of the endurance of ancient materials so much as of the slow changes in design which characterized the proceedings of our ancestors The original material part of the Royal William only lasted twenty-two years, for she was rebuilt, we are told, in 1692, and again in 1719; so that in this respect she compares unfavourably with so modern a vessel as our first ironclad, the Warrior, which has only recently been taken out of the Navy after a service career of not far from 30 years Even now the Warrior has not been removed from the Navy list because she has become worn out, but simply because she has become obsolete If we could reach finality in design—if the inventive brain would reach thanky it design—it the inventve blain would stagnate—there is no reason why the modern iron-built warship should not outlast its wooden predecessor by almost as great an extent as it exceeds it in power of destruction. It is true the natural life of the old ships was a long one The Victory was forty years old when she was engaged in the battle of Trafalgar, and had seen much active service, having been launched at Chatham in 1765, but then she had been laid by as worn out in 1801, and it was only after extensive repairs that she was made fit for sea. A year or two ago, it will be remembered, she was found to be so rotten that she would have sunk at her moorings had she not been taken into dock and in part rebuilt. On the other hand, there is no reason why an irro ship should not last, provided she were properly painted and kept up, perhaps until the era when warships will have become relics of a barbarous past. The expression "properly painted" must be here taken in its literal sense; and with regard, to steel ships due steps must be followed to remove mill-scale, a precaution which has not always been taken of late, as quite recent mishaps have testified

Tassing from hulls to motive power, we find the same Passing from hulls to motive power, we find the same permanence of design more strongly emphasized in the practice of to-day compared with that of the naval era which closed with the introduction of steam and iron bulls. With comparatively small variations in detail the rig of war ships has remained unchanged from the days of Pett down to those within the memory of men still luving. The Henri Graze & Dieu shows a distunctly mediaval rig callhough her fighting-tops are ridiculously like those of our very latest armour-clads—but it would take almost a sallor's get no joint out the differences in said play between

Vandevelde's beautiful painting of the Sovereign of the Seas, "built in 1637," and the ships which appear on the canvases of Stanfeld, Turner, and Cooke. So much for permanence of design with masts and sails; with the succeeding mode of propulsion, engines and boilers, we find as striking a result in the opposite direction Steam machinery was first introduced into the Royal Navy in small gun boats, and later in the paddle-wheel frigates, but it was not until the screw was proved to be the more effective instrument that even the most sanguine engineers could hope that engines and boilers would successfully rival masts and sails as a means of propulsion. We pass over, therefore, the unimportant era of paddle-wheels, but even taking screw engines alone we find that during the last forty years far greater changes have taken place in the design of steam machinery than characterized the arrangement of masts and sails during the two hundred years elapsing between the time the Sovereign of the Seas was built and the practical introduction of steam into the Navy, indeed we might, without any great fear of contradiction, go further and say that to the eye of the engineer there is no greater affinity between the screw engines of forty years ago and those of the present day. than existed between the rigging of the ships of the Norse sca-kings and those of almost our own day, putting on one side only the element of size. The collection of engine models in the Exhibition is far from complete, and is not to be compared with that of ship models. There is a good reason for this, as engineers work to drawings, and models are seldom made excepting as records; whilst their cost is so great as to render them available only for very rich firms The collection of models shown by Messrs. Maudslay, Sons, and Field constitute the greater part of the historical collection in the Exhibition liere may be seen representations of the first types of incre may us seen representations of the first types of steam-engine introduced into the Navy, and we think a comparison of the early engines in this collection with, say, the magnificent model of the Subacyast engines, shown by Messri Hawthorn, Leslie, and Co, will bear out the remarks we have made. What path the progress of marine engineering will follow in future it is difficult to forecast The inventions of to-day always seem to have reached finality, but it is difficult to imagine that any fundamental change can be effected so long as we retain the use of steam as a vehicle for the conversion of heat into work. It may be that a little engine shown in the Exhibition - Priestman's oil engine - may contain the germ of a principle upon which marine engines may be designed in future, and that before we have got far into the twentieth century the marine boiler, with all its costliness and complication, may have become as much a relic of the past as the pole masts and uncouth sails of the Great Harry. Before that time arrives, however, the four-stroke cycle will have to be superseded

"It is, however, the steam boiler, rather than the engine, which has governed the design of ship machinery Fortyto forty-five years ago, steam pressures were not generally higher than 5 to 8 pounds per square inch. With the introduction of tubes in place of flues, which took place between 1840 and 1850, the working pressure rose to 15 pounds per square inch. The square box business and use, and with think per square loss higher than 1840 and 1850, the working pressure rose to 15 pounds per square inch, or not much beyond, unless the staying of the flat suifaces was carried to an undestrable extent. With such a limit of pressure, the simple expansion engine was, properly, the usual type, but when the cylindrical manne boiler was introduced, the average steam pressure quickly note to 60 pounds to the square inch, and the compound engine accessary part of this step in advance, for, with the higher temperature due to the increased steam pressure, it was impossible to pass large quantities of salt water through the boilers without rightly scaling them up. For some time the

difficulty in generating higher pressure steam caused stignation in marine engineering practice; until the substitution of steel for iron in boller making, the advent of new types of furnaces, and improvements in the pressures as high as from 150 pounds to even 200 pounds to the square inch to be carried. The result has been that, for the two-cylinder compound engine, there have been substituted two types of engine, known respectively son engine. The names are maleading, as even the ordinary compound engine expands its steam more than

three or four times.

The growth of the science of marine engine design, which we have so briefly sketched out, may appear, to those who are not engineers, but little more than a record of increasing steam pressures. Undoubtedly a higher steam pressure has been the fundamental reason for these advances, but the carrying out of these successive changes in pressure has necessitated an entire reconstruction of marine engine practice; so that an engine working at 15 category as one working at 150 to 200 pounds pressure Tooth-wheel gearing, which was first used with screw propellers, has long ago disappeared, side levers and trunks are no longer introduced, and the surface condenser has become a necessity. In the old days, with jet con-densers, the boilers were fed entirely with salt water, now in the best marine practice the condensed steam is all returned to the boiler, excepting that which is unavoidably lost, and this quantity is made up by special distillers and condensers, the manufacture of which has introduced a new branch of marine engineering, as may be judged by several exhibits by different firms in the Exhibition. The practice of circulation of refrigerating water through the surface condenser by means of separate centrifugal pump-ing engines has also introduced a distinctive type of ing engines has also introduced a distinctive type of auxiliary marine engine, upon which several important firms have been chiefly employed. Indeed, the increase in auxiliary machinery has been as marked a feature in the recent progress of manne engineering as have been the changes in the main engines themselves. A battleship of the first class will carry between seventy and eighty separate engines, in addition to those used for driving the propellers. These include electric light engines, hydraulic machinery in connection with the working of heavy guns, steering engines, &c As an instance of what is gained by the use of auxiliary machinery, an instance given by Mr White may be quoted On one occasion it took 78 men 1½ minutes to put the helm of the Minotaur Steam gear was subsequently fitted, by the hard over aid of which two men were able to do the same thing in 16 seconds

We do not propose to gave a list of the various objects exhibited, to which we have referred in penning these remarks. The official catalogue performs that function far more completely than we could hope to do. The collection at Cheises is well selected and fairly complete, and the collection at Cheises is well selected and fairly complete, and the collection at Cheises is well selected and fairly complete, and the collection at Cheises is well selected and fairly complete, one of the collection at Cheises is well selected and fairly complete, which was a considered to the Director of Naval Construction. The cost of a too-gan line-of-battle ship at the beginning of the century was about £65,000 to £70,000, armainer The Cost of a too-gan line-of-battle ship at the beginning of the century was about £65,000 to £70,000, armainer principled checters of 1840 was about £10,000, and that of the 121-gan screw three-deckers of 1859 about £23,000, machinery included. The Warrior, completed in 1851, cost over £37,5000, and the Miniothur Class about £48,000. With the increase in see of the Directions@d, and the minothur class about £65,000 with the increase of the Direction of the Silver of Silver of the Silver o

The Mil and Trafator, complete with armament, would represent hitle less than a, million sterling each. The hydraulic gam combines are problem, machinery, and by draulic gam countings also greatly machinery, and private of Nelson's time. The sum paid for the armour alone on one of our latest battleships, such as the Neyal Soverage, would pay for the Natural History Museum at South Kennangton; whilst even a first class torpedo-boat costs as much to build and equip as a 40-gun firgate of Nelson's time.

A GEOLOGICAL EXCURSION IN AMERICA.

I BEG to call to your attention the following short account of a geological excursion planned for the benefit of foreign geologists who may attend the coming meeting of the International Geological Congress in this city in August next. It will afford an exceptionally favourable opportunity for European geologists to become personally familiar with the most important geological behomemen of the United States.

I venture, therefore, in their interest, to request that you publish some notice of it in your widely circulated periodical, with a request that those who desire to take periodical, with a request that those who desire to take not offer that arrangements may be thoroughly perfected beforehand. A single train will carry 75 to 100 persons comfortably I more poin, the party will be arranged in two trains. Arrangements will have to be made before the companion of the party, and you can therefore readily understand the importance of knowing as early as possible how many are to be accommodated.

S F EMMONS, Secretary Washington, D C. May 30.

For the close of the fifth session of the International Congress of Geologists, which is to be held at Washingcongress of vicinity states to be held a washing-ton, DC, from August 26 to September 2, a grand geo-logical excursion has been organized, which presents unusual attractions and facilities for the European geologists who attend the Congress, and who wish to see some of the geological wonders which have become familiar to them through the memoirs of American geologists. The excursionists will start from Washington, on September 3, on a special train of Pullman ves-tibuled cars, which will constitute a moving hotel, being provided with sleeping and toilet accommodations for both ladies and gentiemen, restaurant cars, smoking, reading, and bath rooms, and barber's shop, and so arranged that travellers can pass freely at all times from car to car through covered passages It will accompany car to car through covered passages It will accompany the party wherever the rails are laid in the regions visited, the hours being arranged so that all the most interesting portions of the route will be passed over in the daytime, and stops may be made wherever any object of special interest to the travellers presents itself. American geologists who have made special studies of the different regions visited will accompany the train, and explain their geological structure upon the ground. The main route laid out is over 6000 miles (nearly 10,000 kilometres) in length, and extends over 38° of longitude and 12° of latitude. It is planned to occupy 25 days, and the cost per person will be 265 dollars (1232 francs), which will cover all necessary expenses, of whatever kind, during the trip.

The following are the principal objects of geological interest which will be seen by those who make the

Going westward, the Appalachian Mountains are first crossed, and an opportunity will be had to see the closely appressed Paleozoic rocks which constitute their typical structure. The praine region of Indiana and Illinois, at the southern end of Lake Michigan, its ancient outlet

into the Mississippi River, will be seen on the second day, and the Kettle moraines of the ancient Glacial sheet will be visited under the guidance of Prof. Cham-berlin. On the third day the twin cities of Minneapolis and St. Paul, centres of the great wheat-growing region of the north-west, will be visited, and glacialists will have an opportunity to see one of the time gauges of the Glacial period, at the Falls of St. Anthony, on the Mississippi River

During the fourth day the Great Plains of Dakota will be crossed, and toward its close the characteristic Badland topography of the Upper Missouri region will be seen. On the morning of the fifth day the travellers will leave the train at the entrance to the Yellowstone Park, and during the following week will be transported by stages through the Park region, stopping at rustic hotels established near points of special interest. The various geyser basins, the hot lakes and mud volcanoes, the obsidian cliffs, the falls and canon of the Yellowstone River, the Yellowstone Lake, and other objects of interest. will be successively visited under the guidance of Messrs.

Arnold Hague and Jos P Iddings

On the twelfth day the railroad journey will be resumed, and, after crossing the crest of the Rocky Mountains in Montana, a stop of several hours will be made at the famous mining town of Butte, whose mines produced, during 1890, over 26 million dollars worth of

copper, silver, and gold.

The morning of the thirteenth day will find the travellers on the edge of the great lava plains of the Snake River Those especially interested in volcanic pheno-mena will have an opportunity here of making a side trip across these plains to Shoshone Falls, where the Snake across toese plains to Shosmone Fails, where the Shake river mikes a single leap of over 200 feet, and cuts a narrow gorge 600 feet deep in the andesitic and basaltic lavas. The main party meanwhile will proceed southward into Utah, viewing the desert mountain ranges, the shore-lines of ancient Lake Bonneville, and skirting the shores of its present relic, the Creat Salt Lake, will reach Salt Lake City, the Mormon capital, in the afternoon. A halt of three days will be made in Salt Lake City, which will give the travellers an opportunity of seeing the Mormons, the desert scenery around Salt Lake (with bath in the lake), and the magnificent Wahsatch Mountains The Pleistocene phenomena will be explained by Mr. G K. Gilbert, and the mountain structure and mining geology by Mr. S F Emmons.

On the sixteenth day the railroad journey will be con-tinued across the Wahsatch Mountains into the plateau region of the Colorado River, crossing that stream in the afternoon, and obtaining views of great monoclinal scarps, and groups of laccolitic mountains in the distonce

On the seventeenth day the Rocky Mountain region of Colorado will be entered, through its finest cashon gorges, affording wonderful geological sections. Halts of a few hours each will be made at Glenwood Springs and at the famous mining town of Leadville, which has produced over 150 million dollars worth of silver and lead.

On the cighteenth day the train will descend the great mountain valley of the Arkansas River, between mountain peaks over 14,000 feet high, and through cañon gorges 30:00 feet deep, debouching upon the plains through the Royal Gorge at Cañon City, where a remarkable geo-logical section in the "Hogback" ridges will be visited

logical section in the "Hogback" ridges will be visited a short stop will be made at Pueblo, a great centre of smelting works, and Manitou Springs, in a sheltered smelting works, and Manitou Springs, in a sheltered to the short should be seen at Manitou Strings, the vicinity of which abounds in objects of geological and mineralogical interests, and those who wish may make the ascent of Pike's Peak (14,200 feet) by rail. The twenticth day will be spent at Denvey, the cap tal

of Colorado, a beautiful city of 130,000 inhabitants,

having a view of the whole eastern front of the Rocky Mountains. For those who desire it, a further excursion of ten days or more will be organized under the guidance of J. W. Powell and C. E. Dutton, to the Great Cañons of the Colorado River in Arizona, which they have so fully described in their writings. More detailed visits to the mining districts of Colorado will be directed by S.F. Emmons for those who wish to remain over for that Those who remain over will receive tickets securing them passage to New York by regular trains

when they are ready to start The special train will leave Denver on the evening of September 21, crossing the Great Plains of Kansas and Nebraska and the Mississippi Valley, and reaching Chicago on the evening of the 23rd A day will be given to Chicago, and thence the train will skirt the Great Lakes, Michigan, Huron, and Erie, crossing a portion of Canada, and reaching Niagara Falls on the morning of September 25 Leaving there in the evening, the tra-vellets will descend the beautiful valley of the Hudson River early the following morning, and teach New York before noon of September 26

NOTES

THE Delegates of the University Press have informed Prof. Sylvester that they will be prepared to bear the expense of publishing in quarto a complete edition of his mathematical works We understand that a memorial recommending this course was addressed to the Delegates of the Press, numerously signed by leading mathematicians of the two English Universities, and by eminent members of the French Academy of Sciences

GEOLOGISTS on this side of the Atlantic will learn with deep scret that Captain Dutton, whose admirable memoirs in the Reports and Monographs of the U.S. Guological Survey are so widely known and valued, has been ordered to take up military duty in Texas-a wide pastoral region where his genius as a geological explorer will find no scope for exercise. As a member of the Corps of Engineers, he has of course always been liable to be taken away to mere routine service of this kind, for which any ordinary officer of his grade would be sufficient. But the authorities have hitherto appreciated his remarkable powers, and have allowed them free exercise, much to their own credit and greatly for the benefit of science. Whether a new martinet has resolved to apply the rigid rules of the service we do not know. But surely there ought to be public spirit enough in the United States to put such pressure on the Engineer Department as will make it reconsider its arrangements. It has only one Captain Dutton, and should be proud of him and make the most of him

THE Council of the Royal Meteorological Society has decided to arrange for a general dinner, open to all Fellows and their friends, to be held in commemoration of the catrance of the Society on its new premises. The dinner will take place at the Holborn Restaurant on Tuesday, July 7, at 6 30 p m

THE Committee appointed by the Hebdomadal Council, Oxford, to consider in what way the University could assist in the establishment of agricultural education, with a special view to the needs of the County Councils, have-now submitted their report. By agricultural education the Committee understand instruction in the sciences, or the branches of science, specially applicable to agriculture, employing the latter term with the larger meaning which must have been present to the mind of Dr. Slbthorp when he designated the professorship founded by him the professorship of "Rural Economy" Used in this sense agriculture becomes not merely the science of the cultivation of the soil, but includes the knowledge of its constitution and properties, of its vegetable products, and of the structure, habits, and uses of the domestic animals that are

reared apon it : so that the student has evidently much to gain by a knowledge of such subjects as botany, chemistry, animal physiology, and geology. Taking into account the requirements of the County Councils, the Committee think that the efforts of the University should in the first place be directed to the provision of an adequate supply of persons qualified to be lecturers or teachers; and those members who are most familiar with the wants of the counties lay stress upon the Importance of University teachers possessing credentials of practical acquaintance with the details of farming and farm-life, which has hitherto been only accidentally-if at all-acquired by such teachers. Other classes of persons whose circumstances the Committee think deserving of consideration are young men who go to Oxford intending to Take an ordinary degree, and then, either as landowners or the agents of landowners, to devote themselves to the pursuit and improvement of agriculture; and young men who might go to Oxford with a view to attending such courses of instruction as would be useful to them in agriculture, but without the intention of taking a degree. Dealing with the means already at the command of the University for providing agricultural education, the Committee point out that the professors to whose services resort would most naturally be had are the following the Sibthorpian Professor of Rural Economy, the Sherardian Professor of Botany, the Waynflete Professor of Chemistry, the Waynflete Professor of Physiology, and the Professor of Experimental Philosophy (Physics) In addition to these University Professors, there are the Lee's Readers in Chemistry and Physics at Christ Church, and the Millard Lecturer in Physics at Trinity College, whose courses would probably be open to agricultural students. The Committee sketch the proper course of study for each class of students, and express the opinion that for the organization and supervision of the studies pertaining to agricultural education some further provision is needed than at present exists. In the Sibihorpian Professorship of Rural Economy, which is now vicant, they recognize a foundation capable of being rendered the centre of agricultural education within the University, and they strongly recommend that the duties and emoluments of the chair should be revised.

THE annual dinner of the Royal Hortcollural Scotely was a held on Tuesday evening at the Hivel Mitropole The chair and was laken by Sir Trevor Lawrence, the President The toast of the evening. "The Royal Hortcultural Society," was proposed by Sir James Paget, who spole of the work in which the Society was engaged as one that minutezed to the happiness so and welfare of the whole nation. The President responded, the The Society in own as most prosperous condition, and is to be congratulated on the progress it has made under Sir Trevor Lawrence's leafership.

WE print elsewhere a report of the lecture delivered by Lord Rayleigh at the Royal Institution last week in connection with the Faraday Centenary In commemoration of this anniversary the Royal Institution elected as honorary members a number of foreign men of science, several of whom came to London to be presented with the diploma of membership by the Prince of Wales. As the distinction between the Royal Institution and the Royal Society is not always so well understood in foreign countries as it is in England, the Royal Institution can hardly, perhaps, be congratulated on this "new departure." The follow ing is the list of those on whom the honour was conferred -Edmond Becquerel, Marcellin Berthelot, Alfred Cornu, E Mascart, Louis Pasteur, Paris, R. W. Bunsen, Heidelberg; H. L. F von Helmholtz, A. W. von Hofmann, Rudolph Virchow, Berlin ; J. P Cooke, Cambridge, U.S., J Dwight Mbbs, Newhaven, U.S.; Simon Newcomb, Dana, J. Willard Washington, U.S., Stanislas Cannizzaro, Pietro Tacchini, Rome ; Julius Thomsen, Copenhagen ; T. R. Thalen, Upsala ; Demetri Mendeleef, St. Petersburg ; J. C. G. de Marienac.

Geneva; J. D. van der Waals, Amsterdam; J. Servais Stas, Brussels.

A COMMISSION has been appointed for the reorganization of the Paris Museum of Natural History, and held its first meeting last week under the presidency of the Minuter of Public Instruction The members are MM Berthelot, Bardoux, Burdeau, Charles Dupoy, Darboux, Frémy, Chauveau, Milne-Edwards, and Lazrd

A conversations will be given by the President of the Institution of Electrical Engineers and Mrs Crookes in the galleries of the Royal Institute of Painters in Water Colours on Monday evening, July 6.

On Monday evening, in the House of Commons, Sir H. Roscoe asked the President of the Board of Trade whether he had decided to grant the application of the Committee of the National Institute of Preventive Medicine to become incorporated under the Companies Act, with the omission of the word "limited" in view of the amended proposals which had been placed before him Sir M Hicks-Beach replied as follows .-"The amendment of the proposed memorandum of association referred to by the hon member (by which it is made clear that the grant of the licence now asked for would not in any way maply approval by the Board of Trade of experiments upon living animals, or of any application to the Home Secretary for a licence for that purpose) is, no cloubt, an important change in the proposals of the Institute, and will probably meet the objection stated to the deputation which lately waited upon me. There are, however, one or two other points requiring consideration, but I hope shortly to be able to arrive at a decision on the subject "

Sis Pres-Coll Gardiner Hewert, F.R. S., died on Friday inght last at his residence, Chesinut Lodge, Horsham, Susser. IIc was born in 1812, and in 1836 was admitted a member of the Royal College of Surgeons, of which he was made President in 1876, in succession to bur James Paget.

Witt the approval of the Preudent, the Prance of Wales, the Council of the Society of Arts have awarded the Albert Medial to Sir Frederick Abels, K C B, "in recognition of the manner in which he has promoted as veral important classes of the arts and manafeature, by the application of chemical science, and especially by his researches in the manufacture of iron and of steel, and also in acknowledgment of the great services he has rendered to the State in the provision of improved war material, and as chemist to the War Department."

THI. Report of the Savilian Professor of Astronomy has been presented to the Board of Visitors of the University Observatory, and we learn from it that the photographic telescope, prepared for taking part in the International Chart of the Heavens, is at length complete. The guiding telescope also is provided with a micrometer sufficient to permit the observation ot stars at a considerable distance from the centre of the plate. and the camera end of the telescope is fitted with the apparatus devised by the Astronomer-Royal, and executed by Sir Howard Grubb The Oxford University Observatory is also provided with two researce, supplied through Dr. Vozel, of the Potsdam Observatory, and has very recently added to its equipment a measuring machine of great delicacy for the discussion of the plates taken in connection with the international scheme. Altogether the equipment of the Oxford University Observatory appears to be in a very forward state of preparedness, and Prof. Pritchard congratulates himself and the University that this equipment has entailed no unusual appeal to funds, on which there are so many claims, but has been supplied by the bounty of the late Dr. De La Rue, supplemented by strict economy in the management of the Observatory in former years. The astronomical work of the past year has been mainly confined to the discussion of the parallax of stars of the second magnitude,

and this work is now on the brink of accompletament. Series complete determinations, including that of B Aurigee, have been made in the year, and but it to ther stars, the measures of which are complete, await discussion. Prof. Pritchard concludes his Aegorit as usual, by acknowledging the aid he has received from his two assistants and we are glad to see speaks hopefully of his terostation to complete health.

This President of the French Republic inspected the meteorological instruments at the summit of the Eiffel Tower on June 13, and afterwards visited the Central Meteorological Office, where he witnessed M. Weyer's experiments on the formation of tornadoes, and also inspected the instruments which there reguler the indications of the meteorological phenomena at the top of the Eiffel Tower.

THE French Minister of Public Instruction has appointed Dr. Henry de Varigny, assistant in the Museum of Natural History, to report on the University Extension movement, and has commissioned him to study the question in Edinburgh, London, and Oxford.

THE proposed law on Universities is existing a good deal of discussion in Frame Many local jealouses have been aroused in connection with the question. Every town this bosts to possistion of a tenth rate medical school, or of an inadequate scientific faculty, whelse to have a University, and its political calmir. On the other band, do what they can to peen its claim. On the other band, and the substitution willingly establish five or at most ax large Universities, desire fig passible, to do away with mail and subsets institutions.

A SCIENTIFIC expedition which has been organized in Maine is about to spend some time in Labrador. The principal object of the party will be to collect ethnological specimens. They will take with them a phonograph, with which they hope to obtain some materials for the study of the language and songs of the Eskimo.

In drawing up sciences for the appropriation of the funds of placed at their disposal under the Local Taxation Act, 1800, for the promotion of technical instruction, the County Councils the promotion of technical instruction, the County Councils in the claims of girl's cineation. With a view of adding County Councils in this department of their work, the Committee of the National Association for the her work, the Committee of the National Association for the Committee of the National Association for the Promotion of Technical and Secondary Education has submitted for girls, and included within the stope of the Technical Instruction Acts it is suggested that in each county a committee of ladies should be appointed to devise and carry out a scheme for the technical education of girl.

THE Suster Daily News of June 18 records the birth of a sea iton at the Brighton Aquarium.

On June 18, sixty distinct shocks of earthquake occurred at Serajgunge and Domar, in the Bengal Preudency. Many buildngs were slightly damaged. At Serajgunge continuous earthquake shocks had been felt from noon on the preceding day.

ACCORDING to a telegram from Rome, dated June 22, a strong shock of earthquake was felt that morning at Avighano and at Aquila.

IN his report on the Royal Boiann Gardens, Ceylon, for 1890. F. Timen refers to the kinds of cases on equivation there. There is no reason to support, he says, that they have useler cultivation more than one spectre of Theodoman, but every probability that all the varieties trace their origin to a common wild parsent. It would be interesting to know which for the two fairly well-marked races recognized in Ceylon is the nearest distribution of the control of the two fairly well-marked races recognized in Ceylon is the nearest distribution. The control of t

was erer really a native plant there. It was, however, the sort at one time esclosurely grown in that island, where, having died out, step lace was supplied by the "foreign" sort, no doubt bottlande from the maninad. As seen in Ceylon, the "Croslot" (called also there "Carnoa" and "Old Ceylon Red Casco") presents very little awaterly, but the "Pornstero" shows a redoubt crossing goes on freely in plantations even between the two mans races, and it is well known in Ceylon that seed from a single tree gives a very varied progeny, but a cursous remark was recently made to Dr. Timen by a large grower, who has great opportunities for observation, that the "Pornstero" varieties, which the chiefly enhances, appar to be gradually caractes, which the chiefly enhances, appar to be gradually Ceylon Eck." the seeds loang that dark colore on section, and becomes place or nearly white.

In Himmel and Erde for June, Prof G Hellmann, of Berlin, berns a series of articles entitled "Meteorologische Volksbucher," being an inquiry into popular and typical ineteorological works from the earliest times, and into the nature of their contents. The works to be discussed are more particularly those of Germany, although foreign literature will also find subudiary consideration. Two works are referred to in the present article -(1) "The Book of Nature," by Konrad von Megenberg, which is the oldest natural history in the German language, and was written about the year 1350-nearly a century before the invention of printing. It was first printed in 1475, and went through many su'sequent editions Much attention and original thought was given to meteorological subjects, and the author divided the wind rose into 12 points but the work is to some extent based upon a still unpublished Latin manuscript by Thomas Cantimpiatensis, "Liber de natura rerum," which was written before the middle of the 13th century (2) "Elucidarius" The author of this work is not known with certainty, but is supposed to be Jakob kohel This remarkable work was first published in German, in the year 1470, and was much sought for in 1910st European countries in the 15th and 16th centuries. It deals with a variety of subjects, including meteorology and geography, and many editions were published in various countries Dr Hellmann gives copious extracts from the works, and historical research being a subject in which he carries great authority, his treatment of it will be found both interesting and instructive

MISSES. VIEWEG AND SON, of Brunswick, intend publishing a German translation of Mr Denning's new book, "Telescopic Work for Starlight Evenings"

A Work entitled "Synopus der Hohene Mathematik", by J. G. Hagen, Director die Georgiewom College Observatory, Washington, D.C., is to be published by Felix L. Dames, Berlin The work is the result of labour carried on continously during twenty years, and is intended to present a general view of the higher mathematics. It will consist of four volumes, the first of which will be massed easily in August

A VALUABLE paper on gum-tree, by Mr. D. McAlpine and Mr. J. R. Rendry, has been reprinted from the Transactions of the Royal Society of Victions for 1890. There are several ultistrative plates, the drawings being puniopally reproductions of photographs taken by Mr. Rendry. These drawings show that the transverse section of the leaf-stalk of a basalypt may reveal a pattern useful in the determination of species.

MESSES. GEORGY PHILLIP AND SON have issued the first number of the Blue Peter, a monthly sailing list and review. It is intended that the new journal shall provide ample information for persuan who are about to set out by any one of the principal ocean routes. There will also be articles which may serve to remind ships' officers that "there is substantial [profit to be derived from a scientific training). THE third volume of the *Photographic Recorder* is completed by the June number. The volume is admirably illustrated, and contains a valuable record of all that has been done in connection with photography during the past year.

MESSES W. F. BROWN AND CO., Montreal, are printing for the Government of Canada "Contributions to Canadam Palaeontology," by J. F. Whiteseve, Palaeontology and ACologist to the Canadam Survey. Part iii. of vol 1. has just been tssued. It deals with the fossils of the Devonian rocks of the Mackenine Rwer Datin.

A NOTE by M. Moissan upon the action of fluorine upon phosphorus trifluoride is communicated to the current number of the Bulletin de la Société Chimioue. A short time ago M Moissan described a mode of preparing the gaseous trifluoride of phosphorus The method consisted in gradually adding phosphorus tribromide to warm zinc fluoride, washing the gas first through water, in which it is sparingly soluble, and afterwards drying by means of pumice moistened with sulphuric acid and collecting over mercury. In order to study the action of free fluoring gas upon phosphorus trifluoride as thus prepared, a special piece of apparatus was devised, constructed entirely of platinum and fluor-spar. It consisted of a plannum tube fifteen centimetres long, closed at each end by transparent plates of fluor-spar, through which the phenomena attending the reaction could be observed. The platinum tube was fitted with three side tubes, two of which were placed opposite each other about the centre of the tube, and served for the admission of the fluorine and pho-phorus trifluoride respectively. the third or exit tube was of somewhat wider diameter than the entrance tubes, and was bent so as to serve as a delivery tube over a mercury trough. The whole apparatus was first filled with phosphorus trifluoride, and then the fluorine entrance tube was connected with M Moissan's now well-known apparatus for the preparation of fluorine As soon as the fluorine came in contact with the phosphorus trifluoride a vellow flame was produced and intense action occurred, with the production of phosphorus pentafluoride. The flame appears to be a comparatively low temperature one. On collecting the gaseous product over mercury, it was found to consist very largely of phosphorus pantafluoride, readily capable of absorption by water, and a small proportion of unaltered trifluoride which could be absorbed by potasb. This reaction of fluorine with trifluoride of phosphorus is thus analogous to the conversion of phosphorus triebloride into pentachloride by the action of gaseous chlorine. An interesting reaction has also been observed by M. Moissan to occur between spongy platinum and these gaseous fluorides of phosphorus. When pentafluoride of phosphorus was passed over spongy platinum gently heated in a platinum tube, a partial decomposition was found to occur, and the issuing gas was admixed with trifluoride, and also with free fluorine. The existence of the latter in the free state was abundantly shown by its action upon crystallized silicon When, however, the temperature of the tube was raised to dull redness, a volatile compound, containing platinum, phosphorus, and fluorine, was obtained, which was carned forward by the gaseous current and deposited in crystals in the cooler portion of the tube. When this crystalline substance is heated. it melts to a viscous liquid, which decomposes at a bright red heat. Analyses show that it is a fluophosphide of platinum, probably of the composition 2PF, PtF, analogous to one of the similar chlorine compounds discovered by Schutzenberger, 2PClg. PtCl. M. Moissan expresses the hope that by employing some such dissociating compound as this a purely chemical isolation of fluorine may some day be achieved.

THE additions to the Zoological Society's Gardens during the past week include three Stoats (Mustila erannea), European, presented by Mr. J. S. B. Borough; an Ocelot (Fels pardate 8) from South America, a Red-tailed Buzzard (Butto borcatts), a

Laughing Gull (Larus atricilla) from North America, presented by Sir Henry Blake, K.C.M.G.; a Tawny Eagle (Aquila navioides) from Africa, presented by Mr. K. G. Hay; a Blue-fronted Amazon (Charactic astron) from South America. presented by Mrs. A. G. Mussey; a Grev-breasted Parrakeet (Bollorhynchus monachus) from Monte Video, presented by Mr. J. R. George , four Common Qualls (Coturnix communit), British, presented by Mr J C. Gie; two Chinese Geese (Anser cygnoides) from China, presented by Captain Creaghe; an Egyptian Gazelle (Gazella dorcas) from Egypt, two Abyssinian Guinea Fowls (Numida ptilorhymha) from Abyssinla, two Blossom-headed Parrakeets (Palcornis evanocephalus) from India, a Meyer's Parrot (Pascephalus meyers) from East Africa, three Til etan Crossoptilons (Crossoptilon tibetanum) from Tibet, a Temminck's Tragopan (Certornis temmincki &) from China, deposited; a Vinaceous Amazon (Chrysotis vinacea), from Brezil, nurchased : two Heloderms (H. la ferma sustectum) from Arizona, U.S.A., received in exchange; a Burrhel Wild Sheep (Ovis burrhel), two Mule Deer (Carracus macrotis & 8), & Bennett's Wallaby (Halmaturus bennetts &), two Impeyan Pheasants (Lophophorus impeyanus), bred in the Gardens

OUR ASTRONOMICAL COLUMN.

TRANSIT OF MERCHY—The Government Astronomer as Sydney (Mr. C. Todd, C. M. G.) writes as follow; regarding the transit of Mercury.—Good observations of the transit of Mercury were secured as the Observation, on Sinday, the study is increased as the Contraction, on Sinday, the study is largered the conditions were extremely favourable, the study is many larger of the study of the study of the study is many well and sharply defined, but at the egrees the sun's inab was bosing and the planet was somewhat woodly, rendering it difficult to fix the exact time of internal contact. I observed with the S-inch equational refractor, assisted by Mr. Cooke; and Mr. Sello observed with as B finet freederor.

Observer—C Todd, Power 125.

INGRESS — External Contact

INCKESS -E	ten nat Contact							
			Time					
		h	m.	•				
A About one-third on"		9	10	11				
Internal	Contact.							
B Contact tangential		0	12	6.2				
C Black drop still clinging t	a limb	~	73	23.0				
D. Rupture of black drop , p	teres elected for h							
			13	49'5				
EGRESS-Power 80	. Internal Conte							
E. Formation of black drop	touching limb	2	٥	14'1				
F. Tangential contact				438				
		-	•	43 0				
Externa	l Contact							
Indentation still visible				14.8				
,, ,, barely noticeable		-	- 7	25.8				
	•	:	7	31.8				
Sun's limb complete .		2	- 4	31.0				
Observer-Mr Sells.								
INGRESS.—In	ternal Contact.							
a. Planet nearly on disk, but	not auste	0	12	51.3				
b. True contact, momentarily				13.5				
c. Planet pear-shaped; roln			•,	.,-				
	or pear touching							
aun's limb		. 9	13	50.4				
EGRESS/	nter nal Contact							
a, Pear-shaped contact			0	34.6				
b. True contact .			·	28.6				
		•	•	20 0				
External Contact								

OBERNATIONS OF TRILUPIC LINES—The May number of the Memore did Secretal deef, between the finance contains a paper by G. B. Rizzo on the telluric lines in the solar spectrum. Signor Runo has compared the intensities of the lines A, B, and a at Bosco Nero and on the Nociamolore Mountain. In order to express the variation in the mass of at (i) reversed, the mass of the property of the contraction of the contained of the property of the contraction of the contained of the contained of the contraction of the contained of the contraction of the contained of the contained of the contraction of the contraction of the contained of the contraction of the contraction of the contained of the contraction of the contraction of the contained of the contraction of the contraction of the contraction of the containe

c. Last seen ; or sun's limb judged to be com-

values of e and the mean intensities of the lines at the two stations. The scale of intensity is such that the C line = 10, and the line at 651'55 is unity

SIMILARITY OF THE ORDITE OF CRETAIN AS EROIDS—In the Publications of the Astronomical Society of the Pairfic, No. 15, 1851, Prof. Daniel Kirkwood gives a list of twenty-four asteroids arranged in ten groups, according to the similarity of their orbits. The following are the groups—

Jupiter is held responsible for the perturbations necessary for the development of these groups of asteroid orbits from the primitive solar nebula.

ASTRONOMICAL AND PINNINA SOCIETY OF TOWNSTOthe first number of the Transactions of this Society (1850-01), with which is also included the first Annual Report, has recently been asseed. It contains abstracts of several intercenting pagers of Saturn's rings, by Dr. Uormion, two by Mr. Shearman on coronal photography, and two by Mr. A bullet on the spectracopic. A drawing of a van spot observed on November that the contains of the substraction of the contains of the contains the frontainpiece of the number.

A New ASTEROID (11) -On June 11 M. Charlots discovered the 311th asteroid. Its magnitude was 13

THE ROYAL SOCIETY CONVERSAZIONE

THE Ladies' Son's of the Royal Society was held on the 17th instant, and was very numerously attended. The following were among the chief objects exhibited.

Finger-prints as a mean- of identification, exhibited by Mr.

Finger-prints as a mean of identification, exhibited by MT Francis Galion, F. K. 5. (1) Specimens showing the nature and character of the patierts that are formed by the papillary ridges on the falls of the finges, as well as on the rest of the persistence of the patierts in their essential details, most of the persistence of the patierns in their essential details, most of fingers infascy to age. (3) Method of indexing a collection of fingers prints so that a determination may be quickly arrived at, whether the duplicate of a given specimen so contained in it or not. (4)

prints so that a determination may be quickly arrived a, whether the duplicate of a given specime in contained in it on not (4). Process of making finger-prints, exhibited in operation. Registration of colours in numbers, and apparatus to show the Registration of colours in colours, and apparatus to show the captain colours, exhibited by Captain charge, of B. Every of the different colours, exhibited by Captain charge, of B. Every of the colours of the registration consists in referring any mixed colours to a single wave-length, and a percentage of white light. With the apparatus to show the greater sensitiveness to the eye of different colours, a comparison is made by placing two colours aide by the distribution of the colours of

An optical liliuson, exhibited by Prof. Silvanas P. Thompson, F.R.S. On two rotating dails, A and B, are spin patterns in black and white, which seem to move radulty inwards and out-wards respectively. Let the observer gase facetly of a bout one work of the contract of the part of

NO. 1130, VOL. 44]

Discharge without electrodes through gress, exhibited by Prof J Thomson, F.R. S. The discharge tube in these experiments is made to form the secondary of what is essentially an analocino coil, and the duckarge passer round a clored current material control of the secondary of what is essentially an analocino coil, and the duckarge passer through oxygen J-shows the action of a magnetic field on the duckarge, along the lines of cancel when the discharge passer through oxygen J-shows the action of a magnetic field on the duckarge, along the lines of its retarded. When the magnetic field is "off the discharge takes place in the bull, and not in the tube, when the field is required. When the configure of the duckarge when a gas electrically weaker than suppage of the duckarge when a gas electrically weaker than latter.

A nucled pendulum, allustrating the effect of heat upon the magnetic succeptubility of mickel, e-thinted by Mr. Shelford Bidwell, F.R.S. Nickel, which is ordinary temperatures to a magnetic metal, become non-magnetizable at about 200°C. A magnetiz metal, become non-magnetizable at about 200°C and bangs hike the bob of a pendulum from a double thread, and is deflected to one safe by a magnet which attracts the nickel tongue. The heat of a spirit-inmy placed beneath the tongue was, because the magnetic quality of the nucle, to other the performs an oscillation. On fit return to the neighbourhood of the magnet, however, the tongue has cooled sufficiently to be once more attracted, but after a momentury constact it is again the production of the control of the cont

The mediometer, exhibited by M., J. Joly. This instrument is for determining the melting-points of imuse quantities of substances, by comparison with bodies of known melting-point substances, by comparison with bodies of known melting-point relationship of the properties of the pro

and to the state of the state o

instrinent por canning the titains in Seet gasts even in the property of the

Cup-micrometer, an instrument for measuring the rate of grown of a plant, earbited by Mr. Francis Darrin, F.R.S. A thread is attached to the upper end of the plant, pause over a pulley, and is fasteneed to a weight. If the descent of the weight (which is a measure of the growth of the plant) is estimated by adjusting a micrometer serve earrying a small cup of oil, small a needle point on the weight touches the surface of the dead. The method, a modification of that used by playsman to the dead of the sent of the state of the sent of the state of the sent of the se

Crookes, F R.S

Living animals from the aquarium of the Marine Biological
Association at Plymouth, exhibited by the Marine Biological

Association,
Art metal work, from the factories of Messrs. Tiffany and Co,

in New York, exhibited by Messr. Tiffsay and Co. Representative articles in wrought metals; amalgamation of metals; Photographs of lving consist taken in Torres Straits, exhibited by Mr. W. Savie Kent.

Prof. J. Norman Lockyer, F.R.S., exhibited—(1) Photographs

Prof. J. Norman Lockyer, F.R.S., exhibited:—(1) rhoto-graphs of a group of sun-spots. A series of enlargements of a group of sun-spots shown on the 12-inch sun-pictures taken under the direction of Lieut-Colonel Strahan, at Dehra Dun, India, on December 16, 18, 19, 20, 21, 22, 23, 1887. The spots have December 16, 18, 19, 20, 21, 22, 23, 1887. The spots have been enlarged three times, and it will be seen that great changes been calarged three times, and it will be seen that great changes took place during the period of viability—0.2 Photographs of the temples at Karnak and Edfou. These are enlargements from photographs taken in January 1891, with reference to the orientation of the temples. The photographs show that, notwithstanding the elaborate details of the architecture, the principal axes of the temples were kept perfectly clear from one edd.

to the other.
Prof. W. Roberts-Austen, CB, F.RS., exhibited a new, briliantly coloured alloy of gold and aluminium, and facsimiles of medals asserted to be of gold and of silver, transmuted from bave metal by the aid of alchemy One of the medals bears on its reverse the statement that it was struck in 1675, by J. J. Becher,

in silver transmitted from lead

Mr. Ludwig Mond, F R S, exhibited —(1) Nickel-carbon oxide (2) Pure nickel extracted from nickel ores by means of carbonic oxide. (3) Articles of pure nickel deposited from lickel-carbonic oxide. (3) Articles of pure nickel deposited from lickel-carbonic oxide. (3) (CO)₁). This unique chemical com-pound was obtained in 1890 by Mond, Langer, and Quincke, by passing a current of carbonic oxide over finely-divided metallic passing a current of carbonic oxide over finely-divided measure nickel at the ordinary temperature, and refrigerating the resulting gas. It is a colourless liquid, of high refractory power, boiling at 43°C, and soliditying at 25°C, and is split up again into nickel and carbonic oxide on heating its various to 16°C. It is highly poisonous, while according to Prof. 16°C-cent and 16°C. pointings, when injected subcutaneously in very small doses, a remarkable power of reducing the temperature of animals. The properties of this substance make it possible to volatilize nickel properties of this substance make it possible to voisitine nicket at a low temperature, and to extract it industrially in a perfectly pure state from all other substances with which it is found Articles of pure nickel, and goods plated with pure nickel, are produced by exposing heated moulds or goods to nickel carbonoxide vapour, or to a solution of this compound in sultable

solvents. Specimens of Japanese metal work, including Opinil, or sliders, Vancul, or arrowheady, and I Jisda, or sword-guards, exhibited by Frof. A Il. Church, F.R.S.
Prof. A Newton, F.R.S., exhibited a drawing, the first received in Europe, of Nelsoyint syldidys, a new form of Marupulai of mole-like habit, and structure accordingly, sent by Prof. B. C. Suring, of the University of Adelaids, South Marquijas of mose-use most, and structure accountry, sent up Prof. b. C. String, of the University of Adelaide, South Australia. The first specimen of the remarkable mammal, one of the most unexpected discoveries for many years, was sent from the interior of South Australia by Mr. A. Moineaux to Prof. Stirling, of Adelaide, who contributed to NATURE (vol. XXXVIII) pp. 585, 539 such a notice of it as its imperfect combinion admitted. Il earlierwals obtained other examples, which are fully described in a memoir communicated to the Royal Society of Adelaide. "Four or five of the cervical veriebra are fused. "Four or five of the cervical vertebrae are fused, of Adelaide, "Four or five of the cervacal veriebre are fused, and there is a Keelei steraum. An enormously thick, and short hear of the control of the cont a jou. Darwin

Mr. Walter Gardiner, F. R. S., gave demonstrations of certain important phenomena associated with the absorption and the flow of the water taken up by plants—10! Root pressure Water present in the soil, and containing minute traces of until the salt, as absorbed by the root-hairs an powerfully and in such quantiles as to set up a considerable pressure in the interior of the plant. This "root pressure" may be demonstrated by attaching to the cut end of a stem a manometer containing mercury, or some coloured fluid. Here a solution of ingrounce in water is employed. (2) The transpiration current.

Among the more important factors which determine the flow and ascent of water from the root, upward, is the sucking force and used by the modeled everpown or transprintion of water modeled the modeled everpown or transprintion of water than the second of the water escapes as wapour, and the salt are retained for food. In this experiment the existence of a "transpriation current" is shown by allowing a cut branch to suck up milk, when the movement of the fat globuler suggesters the flow of the liquid. (3) The amount of water absorbed by the root. This may be estimated by unplue measurement, employing some such form of

estimated by simple measurement, employing some such form of apparatus as that exhibited.

Engravings to "Travels among the Great Andes of the Equator," exhibited by Mr Edward Whymper. These illustrations are elections from Mr. Edward Whymper's forthcoming work upon the Great Andes of the Equator (in which he gives accounts of the first arcents of Chimborazo, Cayambe, Antisansi, &c., &c), and includes views on and about the equator at great elevations, incidents of travel, numerous examples of the new elevations, incidents of travel, numerous examples of the new generas and species obtained on the journey; a facismite reproduc-tion of the map of Don Pedro Maldonado (upon which existing maps of Ecuador are based), and the original route survey, and map of Climborazo, made by the author. The work, with 200 cultustrations and four maps, will be published in the present

illustrations and four maps, will be published in the present year by Mr John Murray
Mr W Bateson exhibited (1) models of double super numerary legs and antenne in heetle-, (2) mechanical model showing the usual symmetry of double supernumerary appendages in beetles. Supernumerary appendages in beetles nearly always spring as branches from a normal appendage, and are generally double, being made up of two limbs more or less compounded together. The two extra limbs are always a comgenerally double, oring made up of two imms more or ex-compounded together. The two extra limbs are always a com-fementary fears, one being structurally a right limb, while the other is left. Commonly the symmetry of the parts is arranged as follows —(a) The two extra limbs and the normal one stand in one plane, one of the extra limbs being nearer to the normal limb and one remoter from it. (b) The nearer is in structure and position an image of the normal limb in a mirror stucture and position an image of the normal lumb in a mirror at right angles to the plane in which the three limbs stand; and the tender is an image of the nearer in another mirror beyond their exercit positions may be represented by the mechanical moiel exhibited, in which the extra legar, evolving round the mormal leg, take attudes proper to the positions which they occupy relaively to the normal leg, take normal leg and norma

and the progressive and retrogressive evolution, of art and ornament in British New Guinea. The exhibit is designed to ornament in British New Gunea. The exhibit is designed to show that savage art can be studed as a branch of biology, and that it is only when so treated that it yields its most valuable limited geographical range, and those which have a wide dis-tribution can, in the misjoilty of cases, be proved to be hom-plastic and not homogenetic. The revolution of a particular pattern must be sought in the district in which it occurs, and its developmental thatory can only be saiely attempted when a comparison is made of numerous objects from the same locality The foregoing propositions are illustrated by means of specimens, rubbings, photographs, and sketches of decorated objects from British New Guinea

At intervals during the evening, the Edison loud-speaking tele-Attinerals during the evening, the Enrom bour-speaking ter-phone and Bell's receivers were connected with the performance of "The Gondohers," at the Savoy Theatre, London; the Prince's Theatre, Birminghinm, and with vocal and Instru-mental concert rooms at Liverpool and Birmingham

memal concert rooms at Liverpool and Birmingham. Thotographs of welcane phenomena were exhibited by Dr of the Control of the C

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The following are the speeches delivered by the Public Orator (Dr. Sandys, Fellow and Tutor of St. John's

College) on June 16, in presenting for the honorary degree of Doctor in Science Sir Archibald Geikie, F.R.S., Director-General of the Geological Survey of Great Britain and Ireland; Mr. W. H. Flower, C. R., F.R.S., Director of the Natural History Museum; and Dr. Elias Metschnikoff, Chef de Service of

the Institut Pasteur, Paris.

Salutamus deineeos virum et scientiarum et litterarum la Salutamos demeeps virum et scientiarum et litterarum iauue iliustrem, in Academia Edinensi quondam Geologiae Professorem, Britanniae et Hiberniae explorationi geologicae praepositum, societatis Reguae socium, societatis geologicae praepadem, societatis denique Britannicae scientiarum terminis prorogandis praesiden designatum. Geologiae et geographiae studiosorum in manibus sunt scripta eius plurima, scientiis illis aut docendis sut illustrandis destinata. Etiam aliis loquuntur libri eins ele-gantissime conscripti, quorum in uno Caledoniae montes vallesque per immensam saeculorum seriem causis cotidianis minutatim execulptas furse demonstrat, in altero vitam et res gestas geologi magni, quem Siluriae regem nominaverim, ca quae par est dignitate describit. Viri talis laboribus non modo geologiae fines latius indies propagantur, sed etiam populo

universo studia illa praeciara commendantur.

Duco ad vos geologum illustrem, ab ipsa Regina nuper novo

honore ornatum, ARCHIBALDUM GRIKIR.

Quod e saplentibus septem unus dixisse fertur, ἀρχὴ ἄνδρα δείξει, de hoc certe viro, per honorum eursum satis longum probato, verum esse constat. Regio Chirurgorum in Collegio, primum Museo conservando praepositus, deinde physiologiam et comparativam quae dicitur anatomiam professus, deinceps.

Musei Britannici aedificio novo rerum naturae studius dedicato praefectus est Idem societati et zoologicae, et anthropologicae, et Britannicae, maxima eum laude praefuit In Museis autem ordinandis quam perspicax, in scientiarum studiis populo toti commendandis quam disertus; hominum in diversis generibus capitis mensura inter sees distinguendis quani subtilis, maris denique in monstris immensis describendis quam minutus Ergo, velut alter Neptunus, intra regni sui fines etiam "immania cete veut auter repuuns, intra regni sui nnes einam "immania cete" suo sibi uure vundett iden, anthropologae quoquie in studius versatus, ne barbaras quidem gestes contempsti, sed, velut alter Chremes, homo est, humani nil a se alienum putat. Duco ad vos Regnes societatis socium, virum honoribus plurlmis merito cumulatum, Wilekumu Mierkicum Flower.

Sequitur deinceps vir, qui scientiarum in provinciis duabus, et in zoologia et in baeteriologia quae dicitiir, famam insignem et in 20010gia et in oneceriologia quae utottu, issum in est adepus Primun Ponti Euxin in litore septentrionali zoologiam professus, multa de morphologia animalium, quae invertebrata nominantur, accuratissime disseruit Deinde Parisus rerum naturae investigatori celeberrimo adiutor datus, eis sus rerum naurae investigatori celebertulo attuto datus, ess potlissimum causis perscrutandis operam dedit, per quas genere ab humano morborum impetus hostiles possent propulsari Nam, velut hominum in mentibus virtutes et vitia inter sese configunt, non alter animantum in mentious virtutes et vita inter sese configunt, non alter animantum in corporibus contra pestum exercitus copiae quaedam sanitatis et salutis ministrae concertare perhibentur. Mentis quidem certanien olim in carmine heroico, Psychomachia nominato, Prudentius narravit. Inter eos autem qui corporis certamen experimentis exquisitis nuper explicaveiunt, locum insignem sibi viiilicat vir quidam summa morum modestia tocam magneta stoj vimicat vir quicam summa moram modestia praedius, qiu, velut vates sacer, proelum illud sib sumpati celebrandum, in quo tot cellulae vagantes, quasa milites procur-santes, morborus semina nailgana corripunt, correpta com-primunt, compressa extinguunt. Talium wrorum auxilio februm cohortes paulatim profigantur, et generis humani saluti novum indies affertur incrementum

Merito igitur titulo nostro hodie coronatur e salutis humanae ministris unus. ELIAN METSCHNIKOFF.

Ar the annual election at St. John's College on June 22 the following awards in Natural Science were made "—Foundation Scholarships, continued or increased 'P Horton-Smith, Hewart, Blackman, Woods, MacBride, Whipple Foundation Scholarship awarded it Villy. Echibitona i Purva, Trotnan. Highest College and the College of Ar the annual election at St. John's College on June 22 the

SCIENTIFIC SERIALS.

American Journal of Science, June —The study of the earth's figure by means of the pendalum, by E. D. Preston. The author first deals with the history of the subject, then states the quantities involved, and supports the method of andy in which the figure of the earth is considered separately from its size as determined by measurement of arcs of meridian. The general results of pendulum work are discussed, and the effect of contrential attraction and variations in latitude referred to The best methods of determining the duration of a pendulum oscillabest methods of determining the duration of a pendulum oscilla-tion at a given temperature and pressure are also considered —On the pote-glacial history of the Hudson River valley, by Prederick J H. Mervill The result of the scino of waves-resulted to the present of the scino of waves-ters and elevation, a sense of terraces will be formed, if the land is alonly rating or subsiding with respect to sea-level, an inclined plane of ensoin may be produced. A groung from this and other facts, the author states provisionally that, after the retreat of the continental glacer from the Hudson River valley, the land stood commentar gater from the Indion New Aucy, the land stood for a long time at a lower level than at present. A gradual elevation and extensive erosion of the Champlain estuary deposits in the river valley then occurred, and was followed by a depression amounting to about 100 feet at New York, and which is son amounting to about 100 feet at New York, and which is apparently continuing at the pre-ent day—On alunte and diaspore from the Routa fills. Colorado, by Mhitman Cross—Diaspore crystals, by W. II. Melville—Combustion of gajets under pressure, by R. W. Wood. Anyone who has watched a burning jet of ether yawoow will have noticed that, as the pressure increases, the flame gradually retreats from the orifice and eventually goes out if the pressure is carried beyond a certain point. The author has investigated these phenomena, certain point 16. author has investigated these phenomena, sing various gases. A burning jet of co. align was estinguished when the pressure was equal to 23 centinetres of mercury—that is, when the velocity of the issuing gas exceeded the speed of combustion for the mixture of gas and air.—Allotropic silver part iii, blue silver, soluble and insoluble forms, by M Carey Fart in, blue silver, soluble and insoluble forms, by M. Carey Lea. From the results given in this and preceding papers, the author is led to believe that allotropic and even soluble silver may be formed in numerous ways. The reducing agents may be either a ferrous or a stannous salt, or any one of a variety of organic substances of very different constitutions. From the solubility and activity of this substance, and the parallelism which many of its reactions show to those of silver in combination, it appears probable that silver in solution, like silver in combination, exists in the atomic form -Note on the submarin combination, exists in the atomic form —Note on the automatine channel of the Hudson River, and other evidences of post-glacual subsidence of the middle Atlantic coast region, by A. Linden-kohl —Are there glacial records in the Newark system 2, by Iyrael C. Russell. Facts are additioned in support of the negative bohl—Are there glacial records in the Newar's system i, by lead C Rowell. Facts are adduced a support of the negative coincide by the negative coincide in the negative coincide in the negative coincide in the negative coincide by the negative coincide in the negative coi

SOCIETIES AND ACADEMIES. LONDON.

Royal Society, June 18 — "Results of Hemisection of the Spinal Cord in Monkeys." By Frederick W. Mott, M.D., B.S., M.R.C.P. Communicated by Prof. Schafer, F.R.S.

B.S., M. R. C.P. Communicated by Prof Schaler, F. K. S. While engaged in studying experimentally the connections of the cells of Clarke's column with the ascending mets of the cells of Clarke's column with the ascending mets of the themsection in the lower dorsal region the sensory disturbances produced in no way corresponded with those already obtained by eminent observers.

by ennent observer.

I was therefore led to continue my experiments, and, by
the kind permission of Prof. Schafter, I carried them out in the
same and the schafter of the schafter of the schafter of the
same stone due to him for much valuable advoce and samitance.
The subject is one of great importance from a scentific, as
well as forth a clinical, point of verw. None years ago, a case
occurred in my practice which tended to skake my faith in the
shapilate train by the doctrum of complete and immediate decou-

vation of sensory impulses in the spinal cord, as taught by Brown-Séquard. The experiments which I have performed exhibit the following

principal points of interest :-
(1) Return of associated movements after complete destruction

of the crossed pyramidal tract below the lesion

100

of the crossed pyramidal tract below the festion (2) That all sensory impulses do not decessate in the cord—in fact, they appear to show that certain sensory impulses, e.g. touch, the muscular sense, and localization in space, pass findly up the same side, painful impression up both aides. A peculiar condition known as "allochia" occurs after hemisection.

condition known as "automiria" occurs after neinsection.

(3) The vaso motor disturbances are on the same ride as the lesion, and consist of vaso-dilation, swelling of the foot, and redness with rise of temperature of the skin of the foot (as compared with the opposite side), and fall of temperature in the popliteal space on the side of the lesson, due, no doubt, to paralysis of the muscles.

The degenerations above and below the lesion are limited (4) The degenerations above and below the lesion are limited to the same side when the injury is perfectly unilateral. There are certain facts connected with the degenerations which serve to

show the origin and course of certain long and short tract fibres

(5) Stimulation of the cortex cerebri on both sides some weeks or months after the hemisection had been performed gave, as a rule, results which showed that the block in the spinal cord produced by the hemisection still existed, although there had

been a very complete return of associated movements.

(6) In one case ablation of the leg area on the same side as the lesion in the spinal cord was performed many months after-

Chemical Society, May 2t -Prof A. Crum Brown, F R S . President, in the chsir.—The following papers were read:— Bromo derivatives of betanaphthol, by H. E Armstrong and E C Rossiter. The authors have completed the study of the compounds formed on brominating betanaphthol, to which they have referred in two previous notices (Chem. Soc Proceedings, t889, p 7t, 1890, p 32). In the present paper they give directions for preparing tri- and tetra bromobetanaphthol, and summarise the properties of the bromobetanaphthol, and product of the action of bromine in excess on betanaphthol, has been carefully examined without any substance having been discovered which affords 1 · 2 · 3-bromophthalic acid on oxidation, the discrepancy between the author' observations and the earlier experiments of Smith and Meldols, therefore, yet remains to be discovered — The action of antire acid on mobile. experiments of Smith and Meddos, therefore, yet remains to be discovered —The action of intrin ead on anyhthol derivative as indicative of the manner in which intration is effected in the case of bensenoid compounds generally; the formation of nitro-keto-compounds, by II, E. Armistrong and E. C. Rossitter. The chiloro- and brome-derivatives of betanaphthol when warmed The cnirco- and bromo-certificate of cetan pathol when warmed with nitre acid are converted into derivatives of betanaphtho-quamon; but the formation of these compounds is preceded by that of an unstable intermediate compound. These intermediate compounds, when carefully bested, are converted into derivatives of hetanaphthaquimone. Thus, when nitric acid is added to dibromobetanaphthol, suspended in acetic acid, a clear solution is obtained which, after a short time, deposits a crystalline. substance; if quickly evaporated by filtration, this product is almost colourless, but it decomposes when kept, becoming yellow. This compound, when treated with alkali, yields bromonitro naphthol. Bromobetanaphthol, in like manner, yields a nitro-betanaphthol, and the tri- and tetra-bromo derivatives yield di-and tri-bromonitrobetanaphthol. The authors are of opinion that the intermediate compounds in question are nitro-bromo-keto derivatives, and that their formstion affords evidence that the elements of nitric acid first become added to the bromonaphthol, thus .-

The theory that the formation of such addition-compounds grecodes that of intro-compounds generally, appears to afford a satisfactory explanation of a number of well known fasts which hitherto have remained unexplained. The non-production of the compounds of the compound of the formation compounds of the department of the three compounds of the formation of intro derawitives of phrashes on intrasting hydrocarbons, for if the addition compound lose H.NO₆ instead of H OII a phead would result, thur—

An agent which would tend to withdraw water from the addition compound would increase the production of nitro-compound tion composind would inferease the production of mirro-compound and diminish that of phenol, and it is known that when a mature of nittee and subplurie acids is used, there is less of the phenol derivative produced than when nitric acid alone is employed. A composnd like the addition-compound of benzene, represented above, would obviously be unstable, and prone to undergo on the properties of the properti oxidation, hence the explanation of the large amount of nitrous fume produced on nitrating benzene. The non-production of resinous matters when sulpho-acids are treated with nitric acid resnows matters when supposed are dealed with finite con-to form the corresponding nitro-compound by displacement of the SO_1H group by NO_2 is also elucidated by the authors' theory, the addition-compound formed in such a case would theory, the addition-compound formed in such a case would very readily break up into sulphuric acid and the nitro-derivative —A new method of preparing nitro derivatives, and the tive —A new method of preparing nitio derivatives, and the use of introgen choldle as a nitraing agent, by H. E. Armuse of introgen include as a nitraing agent, by H. E. Armcompounds formed by the addition of the elements of nitric acid
on the bromo derivatives of betanaphilo) upich nitro-derivatives
of the naphthol on treatment with alkali, a bromine atom becoming displaced by NO₂. On treating the addition-compound with sulphurous acid, a practically theoretical yield of the nitro-naphthol is obtained: this method appears to be of general application. The authors have been naturally led to study the action of nitrogen-doxide, NO₂, on un-attracted compounds of various kinds, in the hope of obtaining addition-compounds which by loss of HNO₂ would pass over into intro-derivatives of the substances treated. They find that such addition-compounds are obtained, and on treatment with alkali and reducing pounds are dottained, and on treatment with a listal and reducing-genety yield nitro-compounds. Thus bennaphind) yield 75 per cent. of its weight of intro-betanaphilid, alphanaphthol be-haves similarly. Phenol yields orthe- and para-nitrophenol. The authors propose to study the action of nitros acid and nitrogen dioxide on unsaturated compounds generally from the point of view indicated in this and the previous note.— Narification, by R. Warngton The first section of the paper describes early experiments, showing the existence of an a producing only nitrites, and the means of separating it from pronoung only nitries, and the means of separating it from soil Successive cultivation in ammonizaci volutions made per-manently alkaline with disodium carbonate was found to be a certain method of obtaining a purely nitrous signit. Pasture soil yleided the nitrous agent more readily than arable soil. The introus organism was solated by the dilution method. Cultiva-nitrous organism was solated by the dilution method. Cultivations were made in an ammonium chloride solution with calcium earbonate The nitrous organism oxidizes ammonia to nitrous acid, and has no effect on nitrites. It produces nitrous acid in solutions of saparagliae, milk, uriae, and ures. Grown in broth contaming calcium nitrate, it does not reduce the mirate to nitrate. It requires no organe matter for its naturiton, and its nitrate, it requires no organe matter for its naturiton, and its nitrate in the presence of either aclicium or sodium and carbonate distinctly favours mirification; neutral sodium carbonates greatly hadren mirification. The nitrout organism occurs as nearly meaning the paper deals with the nitrit organism. The results show that the nitrit organism develops freely in anonymic carbonates are present. Monocodium carbonate, 1-4 grams per litre, exerted a very favourable influence; 6 grams per litre, a returning misense. Dissolution achionate greatly hinders the action. The nitric organism produces nearber altered to mise of the content of the parties or nitrates for mirrate in minuscial colution. The the absence of solutions of asparagine, milk, urine, and ures. Grown in broth

ammonia, it energetically converts nitrites into nitrates, the presence of ammonia is apparently a great hindrance to its action. An attempt to isolate the organism failed. The nitrification performed by soil thus appears to be the work of two
organisms, one of which oxidizes ammonia to nitrite, while the
other oxidizes mirrite to nitrate.

conter consuces turne to nurse. — Sir Archibad Cerkie, F. R. S. Descolegical Society, June ere a bommentement of the general business, Frof. Blake rose on behalf of those present at the meeting to congruntate the President on the honour that it had pleased Her Mujesty to confer upon hum. No was deserved, and the closelgical Society would doubtless teel also the honour conferred on their scene is the person of their President and the head of the Cerboglical Survey of the United Freedens and the head of the Geological Survey of the United Kingdom.—The following communications were read—Note on some recent accessions, in the Wellingson College dutter? —Note on deposits on the south coast of England, by Mr. Affred Bell Communicated by Mr. R. Alberdage, F. R.S. The author's object in this paper is to trace the successive stages in the development of the present coast of the north sade of the English Channel, and to sceration the sources of the diversified of the present coast of the north sade of the stages of the control of the present coast of the north sade of the control of the present coast of the north sade of the control of the present coast of the north sade of the control of the present coast of the north sade of the control of the present coast of the north sade of the control of the present coast of the north sade of the control of the present coast of the north sade of the The first traces of marine action on the south coast in post-Textary time, are found on the foreshore in Biack-leaham Bay. The subtor's reading of the section is somewhat different from that of the late Nr. Godwin-Austen, and he divides the marine series unto (1) an estuarine clay with Mollusca common to estuarine flats, (2) a compare hard mod, and (3) a bed of change from estuarine to uterp-water conditions. A full his of this Selesy fossile is given, including, amongst other animals, pawards of 200 Mollusca. Of 35 process of Mollusca sont now living in Britain, the majority exist in Lisatianian, Medisterrates, or Aircas waters, furthermore, nearly 45 per cent. of the Mollusca are common to the older Crago of the eastern consurance and continuous control of the Changel Bulberton of the post-Tertiary times, are found on the foreshore in Bracklesham adleate the further opening of the Channel subsequent to the formation of the Severn Straits, and believes that this fauta tormation of the Severn Straits, and believes that this fauta represents the deposits wanting between the Selsey mud-deposits and the erratic blocks which, according to him, overlie the mud, these Porlland shells indicate an intermediate temperature, "rather southern than northern," according to Dr Gwyn ure, ""suber southern than northern," according to Dr. Gwyn pelfersy. In conduction, datails concerning still never beds are given, and into of fessils found theren, and the author observed from the conduction of the conduction of the conduction of the finally opened up, beyond the suggestion of Mr. todown-hasten that, if the Sangatie beds and the Coombe Rock are of the same period, it usus have taken place after their formation After the reading of this paper some remarks were made by Mr. Etherdeg, Mr. C. Real; Port Hull, and the author.

Mathematical Society, Jane 11—Prof. Greenhill, F.R.S., President, In the chail—The following communications was made:—Systems of spherical harmonics, by E. W. Hobbson—On the motion of a liquid ellipsoid under its own attraction, by D. M. J. M. Hill.—On certain properties of symmetrics, skewsymmetric, and orthogonal matrices, by Dr. H. Taber—An application of the method of images to the conduction of heat, by G H Bryan—A property of the circum circle, by R

CAMBRIDGE.

Philosophical Society, June 1.—Prof. G. H. Darwin, President, in the charr—The following communications were made:—On the part of the parallactic series of inequalities in the moon's motion which is a function of the ratio of the mean the moon's motion which is a function of the ratio of the mean parallactic series of including the parallactic series of including the parallactic series of the parallactic series, by Mr. W. Richmood. The author applies Cremona's method of deriving the hexagram by projection of the incluse on a nodic tobus narkose from heads. By use of a new form of the equation to this surface the equation of the lines are obtained in a perfectly symmetrical form, and of the lines are obtained in a perfectly symmetrical form, and leamlisticates and other inverses of comic sections, by Mr. R. S. Cole.—Some exprements on liquid electryods in vaccinan tubes, lemitiscates and other inverses of cours excitons, by Mr. R. S. Cole.—Some experiments on iquid electrodes in vacann tabes, by Mr. C. Chree. Thu paper describes some experiments andertaken at the suggestion of Prof. J. J. Thomson on the electric discharge through vacuum tubes in which one or both of the electrodes were liquid surfaces. The liquids employed were mercury and sulphure acid. The electrodes whenseloid were

of platinum or aluminium. Observations were taken of the of plainum or aluminim. Observations were taken of the differences penented by the discharge when the substance of an electrode was altered. The experiments were mostly at low of the phosphorescence then accompanying the discharge.—On gold the alloys, by Mr. A. F. Laurie —Note on a problem in the livear conduction of heat, by Mr. C. M. Bryan

EDINBURGH Royal Society, June 1—Prof Chrystal, Vice-President, in the chair—Prof. Tait communicated a paper, by Prof Piazzi Smyth, on two series of enlarged photographs, one in the visible, the other in the invisible, of the visit of the solar vasible, the other in the invisible, of the violet of the solis appertum. The paper was accompanied by the photographs appeared to the properture of the paper was recompanied by the photographs served by Mr. Smyth in the summer of 185a, and extend to an extreme disance in the invisible violet. The previous observations were included in sixty plates, in the present series, twelve more plates are added in the voilet region, and two independent more plates are added in the voilet region, and two independent tions were included in sixty plates, in the present series, twelve mere plates are added in the wolfer region, and two independent mere plates are added in the wolfer region, and two independent agree with those of Prof. Rowland in microting that the Fraun holder line, "third it of "is either entirely absent now from the solar spectrum, or has become very asimportant.—Mr R. Kid son read a paper on the foreity institute of the Klimatrons, Cultion, are described in the paper belong, with one exception, to the Lower Coal measure.—Prof. That communicated the second and third parts of a paper, by Prof. C. G. Knott, on some relations between magnetism and twent in roon, nacke, and colabilities that the produced in the magnetism that were the combined influence of circular and longitudinal magnetizations. A rectangular roof of cohait twists, like nucled, lelt-handedly, not not the complex of the comp low heids, twist most when the current is reversed. Hystereshs were yether in all the phenomena Evotement sever in this given in Part I., for the twist in terms of the elongations in a thin walled tube of given radius. Part III contains a discus-sion of the magnetic consequences of twisting a magnetized wire —more, especially a circularly-magnetized wire. The peculiar manner in which the magnetic change sometimes lags behind the stress, sometimes shoots ahead of it, is fully investigated. This effect is found to depend upon the strength of the current, on the amount of the twist, and on the amount of vibration to which the wire is subjected. The longitudinal polarity which water the write is subjected. The configuration is country when it acquired when a wire carrying a current is twisted appears to be high in comparison with the intensity induced at the circumference of the wire. This seems to indicate the existence of molecular groupings which alter their configuration when subjected to change of stress or of magnetic force. The effects when the configuration when the configur which are observed when an apparently demagnetized wire is which are observed when an apparently demagnetized wire is subjected to twist suggest that magnetized wire may in certain circumstances consist of alternate layers of opposite polaritate. Any stress which acts differently on these layers will produce powerful magnetic effects. From his own experiments and those of other observers, Dr. Kaott concludes that the first effect of a shearing stress on the molecular groupings is not only to increase the average intensity in the direction of the magto increase the average intensity in the direction of the mag-ienting force, but also to bring isto promisence a relatively high intensity in directions at right angles to it—IP. Buchan commanicated a paper by Mr R. T. Gomod's Appentications to between, on the winds of Ben Neils. The exact determination observer, on the winds of Ben Neils. The exact determination of northerly wands is not very early, owing to the shape of the hill. The cliff, 2000 feet in height, which forms the squally and succertain. Some may be entered on the record or north-west. Somethern winds are on the whole slightly more as north when they should really have been entered as north-east, ontenth-was, Southern wands are on the whole slightly more frequent than northerly winds are. At sea-level the most frequent wand is west, and south-west, west, and north-west include nearly half of the total observations—more than half of calms are excluded. These low-level winds are in exact according to the control of the con

ance with the distribution of barometric pressure over the British Isles according to the Buys Ballot's law, which asserts that British lates according to the Buys Ballot's law, which asserts that the winds blow counter-lockwase round areas of low pressure, such an area lying to the north of the British Isles. But the Ben Nevis winds do not fit in with such a distribution of pressure at all, which indicates that isobars drawn at the level of Ben Nevis (4400 feet) have directions differing entirely from the directions of sea level isobars. In other words, the distribution of average arometric pressure which extends over the North Atlantic an North-western Europe, and dominates the surface wind over that area, does not in this country extend to a vertical height of one area, aces not in this country extend to a vertical neight of one mile. Precaultions were taken to make certain that this difference was not due to a difference between the methods of observation at Ben Nevis and at low-level stations. If a cyclonic storm of small area is jying to the north eastward, the sea-level winds are west or north-west, but the Ben Nevis winds may be north-east, blowing straight out from the centre of the area of low pressure. In larger storms the Ben Nevis winds are practically identical with the sea-level winds, which indicates that a storm has a vertical extent proportionate in some way to the horizontal area which it covers fhe outflowing wind seldom or never occurs when the centre is to the south or west, but only when it is to the north or east, and it is most s'rongly marked when an anticyclone lies on the other side. The outflowing current seems to carry the ascending air of the cyclone to the descending anti-cyclonic regions The non-observation of the outward current c regions when the centre of the cyclone lies on the south or west may be due to the fact that it passes at a higher level than the top of the mountain, for it thea consists of air passing from hotter to colder regions, which will presumably rise to a higher level. The veering of the wind at great heights, which should occur according to the usual theory of cyclones, is very rarely observed. —Dr Crum Brown read a paper, by Dr A B Griffiths, on the blood of the Invertebrata.

PARIS

Academy of Sciences, June 15—M. Dechritre in the hear—On the deforsation and extension of noisited or periodic acrial waves propagated in the interior of delivery tibes without water and of indefinite length, by M. J. Housiness—Ci. a vokatile compound of iron and carbonic locations of the compound of

by M. D. Gerner. By measuring the proportions of salts as unbunan which give the maximum rotatory effect on polarized light, the author arrives at the molecular formula of the compounds formed — Os quinethyline, a homologous base of quantes, by MM. E. Orimeax and A. Armedi.—On urders of the control of formation of methyl-campbe-earhorates of methyl and ethyl, by M. J. Th. Muller.—Bleeching of cotton by oxygenated ethyl, by M. J. Th. Muller.—Bleeching of cotton by oxygenated exists on the control of the control

BOOKS, PAMPHLETS, and SERIALS RECEIVED

The Gypts: W. K. Brods (West) — Do F. Exercise chee las Adules
Dr. F. Legrane, (Four Askard, — Bulletin of the United States Bink Com
Dr. F. Legrane, (Four Askard, — Bulletin of the United States Bink Com
Harmande May M. Genestreet, Cycoli, — All production to the Mathemanual Labory of Determiny and Magnetism. W. T. A. Entage (Cheredon
Balletin) — Labory (Barton) — Bernelling (Cheredon
Labory — Bernelling — Bernelli

CONTENTS.	PAGE
Educational Aspects of Free Education .	160
Differential and Integral Calculus By G. C	170
The Geology of the Country round Liverpool	v ''
Prof W Boyd Dawking, F.R.S	172
Our Book Shelf'-	-,-
Trouessart "Les Microbes, les Ferments, et se	s
Moisissures"	173
"Botanical Wall Diagrams"-D. H. S	173
"Chambers's Encyclopædia"	. 173
Wilson "Glimpses of Nature"	. 174
Letters to the Editor	
The Fusing and Boiling Points of Compounds (Wit	
Diagrams)-Dr Gustavus Hinriche .	174
Porpoises in African Rivers - Willy Kukenthal	175
Physical Science for Artists, I By J Norma	
Lockyer, FRS.	. 175
The Faraday Centenary (With Diagram.) By Lore	1 .
Rayleigh, F R S	178
The Royal Naval Exhibition	180
A Geological Excursion in America. By S. F.	
Emmons	182
Our Astronomical Column:-	. 183
Transit of Mercury	. 186
Observations of Telluric Lines	186
Similarity of the Orbits of Certain Asterolds	187
Astronomical and Physical Society of Toronto	187
A New Asteroid (811)	. 187
The Royal Society Conversazione	. 187
University and Educational Intelligence	. 188
Scientific Senals	189
Societies and Academies	. 189
Books, Pamphiete, and Serials Received	192

THURSDAY, JULY 2, 1891.

CRYSTALLOGRAPHY

Elements of Crystallography for Students of Chemistry, Physics, and Mineadogy By George Huntingdon Williams, Ph.D., Associate Professor in the Johns Hopkins University Second Edition, Revised, pp. 246, with 383 Woodcuts and 2 Plates (London: Macmillan and Co, 1890)

THE position which crystallography ought to occupy in a scheme of scientific education is far from belog generally recognized. Every day the impligit and performance of the property of the p

If we take any standard treatise on physics, we shall find that the subject of the measurement and calculation of crystal forms is almost, if not entirely ignored, and though it is, of course, absolutely impossible to discuss optical and other physical phenomena without reference to the wonderfully suggestive relations which exist between the properties resulting from internal molecular structures, and the crystalline forms which are the "outward and visible sign " of such molecular structure, yet the references are usually vague and, not unfrequently, misleading In confirmation of this statement, it may be mentioned that in a very widely-used treatise on physics -one that has passed through many editions in this and other countries-there is a hopeless confusion between the terms "hemihedrism" and "hemimorphism" in the account which is given of the remarkable phenomena of pyro-electricity.

Nor, as a rule, have chemists dealt more adequately with the subject of crystallography than their brethren the physicists. In many chemical treatises we find such terms as pyramidal, pirsmatic, octahedral, rhombodal, &c, employed so loosely as not to give the student the faintest idea of the real symmetry of the forms which are referred to. This neglect of crystallography by chemists is seen to be the more senious when we remember two important circumstances—first, that crystallization is often the only means which chemists possess of isolating and readily distinguishing many bodies; and secondly, that new substances are being continually formed by the chemist, the study of some of which may throw new and important light upon crystallographic principles.

Mr Fletcher, in a very suggestive address to the Mineralogical Society, has justly remarked —

"Hitherto, at least, the chemists of this country have been too content, either to leave the crystalline forms of their artificial products undetermined, or to impose the ake of their determination on the already sufficiently determined to one of the already sufficiently factory, system of education every chemist should be taught how to measure and describe the crystalline characters of the products which it is his fate to call into characters of the products which it is his fate to call into existence. A Kowledge of the elements of crystalline graphy, including the muchanics of crystal-measurement, at every University."

The consequence of this neglect of crystallography by physiciats and chemists has been that the teaching of crystallography has fallen almost entirely into the hands of mineralogists and geologists. But there is no more reason why every book on mineralogy should commence with a crystallography terusities, than that it should include dissertations on refraction or articles on chemical analysis. "Crystallography should be taught as a special subject," and the student who, after his training in physics and chemistry, takes up the subject of mineralogy, ought to know at least as much of the measurement and symmetry of crystal forms, as he does of the effects of various media on different kinds of radiant energy, or the reactions of the several bases and acids

It would be easy to show that, much as mineraloguists have done for the study of crystallography, the latter scenec would have been developed more logically, and perhaps more rapidly, if the illustrations of the phenomena of crystallusation had not been so exclusively sought among natural products. We find not a few examples in the terminology of the science of the effects of this one-sided growth of crystallography.

Crystallography is based upon purely mathematical considerations, and the study of the principles of crystal-measurement, the discussion of crystal-symmetry, and the calculation of fundamental forms, ought clearly to be one of the first branches of applied mathematics to be taken up by the student of physics; thus the study of crystallography should certainly precede that of physical optics. If this course were followed, the student of chemistry and mineralogy would come to the teachers of those sciences with such an amount of prefuminary information as would enable him to profit by their instructions.

In the work now before us, Dr Williams fully recognises the importance of the principles for which we have been contending, and has endeavoured to supply Englishspeaking students with a short and clear treatise on the principles of crystallographic science. It is certainly emarkable that the countrymen of Wollaston, Whewell, and Miller should have had to wait so long for a work of this character; though every student of the subject must subject must gratefully remember the aid afforded by the admirable little primer prepared some years ago by Mr. Gurney, and published by the Society for Promoting Christian Knowledge.

of Dr. Williams's qualifications for undertaking a work of this kind it is unnecessary to speak. His numerous original researches afford abundant evidence of his devotion to crystallographic study, and in the preparation of the work he has had the advice and assistance of one of the first crystallographers of the United States, Prof. S. L. Penfeld, of New Haven

In order to keep the work within the smallest possible limits, it has been restricted to geometrical crystallography, but otherwise the work has been modelled upon the same lines as Groth's standard work, "Physikalische Krystallographie" The plates and very numerous woodcuts afford the greatest possible aid to the reader, and the typography leaves nothing to be desired. In looking through this revised edition, we are struck with the almost entire absence of those typographical errors that are one saily creep into a work of this kind, and which, though so obvious to an expert, often prove to be a source of infinite trouble to the beginner.

In dealing with the vexed question of crystallographic notation, we think Dr. Williams has exercised a very wise discretion. The simple and easily understood symbols of Naumann have been employed in the first instance, but in almost every case the corresponding symbol of Miller's system has been added in brackets. While all students of physics, chemistry, mineralogy, and geology ought to equip themselves with such an amount of crystallographic knowledge as may be derived from the study of this book, only a very small proportion of them are likely to be called upon to deal with the higher and more complicated problems of the science The small minority of students who devote themselves to purely crystallographic researches may be fairly recommended to employ from the first the beautiful method of notation devised by Whewell and perfected by Miller: but it is more than doubtful if the student with a smaller amount of mathematical training would gain any real benefit from such a course. In an appendix, "on zones, projection, and the construction of crystal figures," the author of this work has indicated to such a beginner the nature of some of the methods of investigation which are pursued by more advanced students.

In any future edition of the work—and such, we feel sure, will certainly be called for—we think that the author would do wisely to add a table showing the symbols of the chief forms according to all the different systems of notation commonly employed. The student who turns to the classical memors of Des Closzeaux, Mallard, Bertand, and others of the French school of crystallography, would thus be enabled to avail himself or much valuable literature, which, owing to the employment of an unfamiliar notation, must otherwise remain a sealed hook to him.

We have spoken regretfully at the outset of this notice of the general neglect of crystallographical studies; but we are compelled to admit that, for this neglect, crystallographers themselves are largely to blame The confusion produced by numerous rival systems of notation is answerable for much of that feeling of despair among those who attempt to make themselves acquainted with the subject. If the time has not yet arrived when a uniform crystallographic language can be agreed upon, much might be accomplished if the plan adopted by the author of this work of giving in every case the symbols according to fwo systems were followed. This is already done in the Zeitschrift fur Krystallographie, the Neues Jahrbuch fur Mineralogie, &c , the Journals of the English and French Mineralogical Societies, and several other wellknown periodicals If a conference of the leading crystallographers of Germany, France, and England could be held to decide upon the order in which the axes should be aken in writing symbols and other similar arrangements which are purely conventional and arbitrary, we might hope to see much of the confusion removed that has so long been a bar to the progress of this most fascinating and important branch of science

We feel assured that the simultaneous publication in this country and in America of so simple and at the same time so accurate a text-book of the subject as the work we are now considering will do much towards reviving and diffusing a taste for the study of crystallography. The student who masters the contents of this little book will undoubtedly have much more to learn before he is competent to deal with all the higher problems of crystallographic science; but, however far his researches may be carried in the future—and this is, perhaps, the very highest praise we can give to the book—he will certainly have little, if anything, to unlearn.

JOHN W. JUDD.

PHOTOGRAPHY IN COLOURS.

Photographie des Couleurs par la Méthode Interférentielle de M. Lippmann. By Alphonse Berget. (Paris . Gauthier-Villars et Fils, 1891.)

THIS interesting little brockure contains an account of the recent achievements in colour photography which have been made so widely known to the English public through the daily papers. Coming from the pen of an "attaché au Laboratoire des Recherches (Physique) de la Sorbonne," we may take this contribution as an authorized exposition of M Lippinann's work, and as such it will be found useful by physicists, chemists, and photographers, as well as by the general reader who wishes to know the real state of the case concerning this important departure in photographic methods. In a short historical introduction the author calls attention to the previous photochromatic attempts by Seebeck in 1810, by Herschel in 1841, by Edmond Becquerel in 1848, by Niepce de St Victor in 1851 to 1866, and by Postevin in 1865. It is stated that these and all similar attempts were based upon purely chemical methods, the investigators seeking for some sensitive compound which would give chromatic impressions corresponding to the colours impinging on the film M. Berget adds the important remark "a priori, ce problème est irréalisable "

Chapters is to v are devoted to elementary optical principles. Chapter ii. deals with vibratory movements and their propagation, wave-length and period, and sonorous waves. In the third chapter the phenomenon of interference is described and explained; in the fourth chapter we have sections on the luminiferous ether, the velocity of light, the decomposition of white light by a prism, and Fresnel's theory of the spectrum colours The subject of complex colours, as distinguished from the pure colours of the spectrum, is also dealt with in this chapter, and is of special importance in connection with the colours of natural objects, to which the author devotes a short section. It is pointed out that the principle of superposition of vibrations holds good in optics as in acoustics, and that just in the same way that the diaphragm of a phonograph can take up and faithfully transmit the extremely complex system of superimposed aerial vibrations produced by the human voice, so the ether transmits the complex superimposed vibrations emanating from coloured objects. In connection with the history of the undulatory theory, the whole credit is given to Fresnel: "L'honneur de donner la première théorie rationelle de la lumière, en la considérant comme résultat d'un mouvement ondulatoire, était réservé à un savant français: Fresnel" We should like to have seen Thomas Young receive at least an honourable mention

The subject of interference receives more detailed treatment in chapter v, the interference of direct and reflected waves, and the theory of Newton's rings, being specially dealt with. It is not till we come to the sixth chanter that we are introduced to the main subject of the brochure. The principle which guided M Lippmann in his experiments is well and tersely given. Imagine a plane metallic mirror with its reflecting surface coated with a transparent, homogeneous film of a silver haloid in albumin or collodion. Supposing a coloured ray of definite wave-length to fall on such a film, the undulations would traverse the transparent sensitive film, and being reflected from the polished surface of the mirror, and meeting the incident waves, would produce interference The snace in front of the mirror would thus be occurred by parallel planes alternately light and dark, and separated by half wave lengths, i.e. by spaces of 1/4,000,000 of a millimetre. Phere is therefore aimple space, even within the thickness of the film for several of these planes of interference On development, the planes corresponding to the light intervals would alone give films of metallic silver, while the dark intervals would remain unaffected On fixing, there would thus be left in the film a series of parallel films of metallic silver separated by half wavelengths Any pair of such films constitute a thin plate in the Newtonian sense, and will give by interference a colour corresponding to that which produced the original deposition of the filins when viewed by reflected light,

To realize the foregoing principle experimentally, M Lippmann has found it necessary to use dry films of collodion, or albumin, or relating sensitized by immersion. as in the old wet collodion process; emulsions are granular and opaque, and contain particles which are gross in comparison with the half wave-length of a spectrum colour, and cannot be used. Moreover, it has not been found practicable to coat the reflecting surface of the mirror directly with the sensitive film, because the free todine tarnishes the silver and destroys its reflecting power. This difficulty has been surmounted by making the coated glass plate one side of a shallow trough with parallel sides filled with mercury, the coated side being inwards, and in close contact with the mercury The conditions for reflection and interference are thus fulfilled. The image of the spectrum is focussed on a glass plate with a ground surface, which is temporarily fixed to the side of the cell or trough in the same position as that occupied by the sensitive plate, i.e. with the ground surface inwards. After focussing, the ground glass is removed, and the sensitive plate substituted for it in the position described

The spectrum was produced by an electric arc light of 800 candle-power, and the time of exposure for the different parts of the spectrum was regulated by interposing cells with coloured solutions, beginning with a solution of helianthin which transmits only the red and yellow, then replacing this by a cell of potassium dichromate which transmits the red, vellow, and green, and then finally exposing for a few seconds without any screen, so as to impress the blue and violet. The whole time of exposure varies, according to the sensitiveness of the film, from half an hour to two hours. The details of development and fixing are given by M. Berget, and do not differ fundamentally from the ordinary methods.

The finished image, when dry, shows the spectrum colours by reflected light with metallic brilliancy, and as the colours are purely optical, depending only on reflection and interference, they are permanent. As the author points out, it is certainly a marvellous tribute to the fidelity of the photographic method that a series of laminæ of metallic silver separated by intervals of only about 1/4,000,000 of a millimetre should retain their positions with optical accuracy during the processes of fixing and development

There can be no doubt-as will be admitted by all who have seen the results-that M Lippmann is to be congratulated on having made a most important advance in the methods of photochromy. How far his experiments go towards the realization of the great problem of photographing objects in their natural colours is a question quite distinct from his present achievement. M. Berget tells us that satisfactory reproductions of coloured glasses illuminated from behind by the electric light have been obtained, but this is only a very little step in the desired direction

"One reste-t-il à faire pour rendre absolument usuel le procédé photochromique de M Lippmann?" There remains a great deal! Not the least of the requirements is a transparent sensitive film equally sensitive to every colour of the spectrum, and sufficiently sensitive as a whole to enable the impression to be secured with a moderate exposure, instead of 30 to 120 minutes. Till this is accomplished we are not much nearer the solution of the problem of photography in natural colours than we were before M. Berget speaks hopefully of the prospects in this direction, and we wish every success to his anticipations. But it is no detraction from the merit of M Lippinann's results if these have no immediate bearing on practical photographic processes As a triumph of physical science these experiments will live.

"C'est aussi un triomphe pour la science française, car ce mode de reproduction des couleurs du spectre à l'aide des lames minces limitées par des plans d'argent constitue une matérialisation, réalisée par un savant français, de ces ondes lumineuses conque pour le première fois par le puissant génie d'un autre Français illustre : j'ai nommé Augustin Fresnel."

With this patriotic outburst M Berget concludes his pamphlet, and the compatriots of Niepce and Daguerre may well be gratified with this latest emanation from the physical laboratory of the Sorbonne.

R. MELDOLA.

OUR BOOK SHELF.

Geometry of Position By R H. Graham, Author of "Graphic and Analytic Statics." (London and New York: Macmillan and Co, 1891)

THIS work essays to fill an existing want by providing an English text-book on the important subject of geometry of

position in relation to graphical statics.

The author gives an introductory chapter on anharmonic pencils and ratios, followed by an interesting chapter on projective conics, and devotes the remainder of the book to the application of graphic methods to statical problems including, amongst others, the discussion of Maxwell's theory of reciprocal figures.

The chapter on anharmonic pencils and ratios would have been considerably improved by the introduction, at

the beginning, of more definitions and explanations of the

nomenclature adopted. The proofs of Desargue's theorem and its converse, given on p 3, are unduly compressed, considering the early stage at which they are introduced. and the student's preliminary difficulties will be increased by the fact that the enunciations have been given in succession, while there is nothing to indicate which is to be treated first.

In the chapter on reciprocal figures, we would suggest that the proof given of Theorem I, Art 50, might with advantage have been dispensed with. In Art. 52 it is erroneously assumed that OB' is equal to force (1); this assumption mars a proof which would be otherwise good. The work exhibits evidence of originality, and it is, perhaps, to be regretted that the proof-sheets have apparently been revised only by the author himself. Their revision

by one who had no part in compiling them would probably have contributed to a better arrangement, and to the exclusion of much that is vague.

The carefully drawn diagrams of different problems contained in the book form admirable illustrations to the non-technical reader of the nature of the operations involved in the application of the graphical calculus, and of the character of the results obtained by it They are the more welcome as such information is not readily available in English text-books, while in foreign treatises it is often developed in such minute detail as to make the foundations nearly inaccessible to the general reader

A word of praise is due to the interesting collections of examples at the ends of the chapters, which are, it seems, mostly original, but partly drawn from sources not often laid under contribution in the ordinary text-books ALEX, LARMOR,

The Species of Epilobsum occurring North of Mexico By Dr Trelease, Director of the Missouri Botanic Garden From the Second Annual Report of the Garden, issued April 1891 48 pages, 48 plates

EPILOBIUM is not a very large genus, but is spread universally through the north temperate sone, both amongst the plains and mountains, and reappears in plenty in New Zealand The species are very difficult of delimitation and definition, and great diversity of opinion has prevailed as to their number, and the validity of the characters which have been used to characterize species. It is evident, moreover, that many of them hybridize freely in nature Passing over the earlier well-known writers, such as Pursh, Muhlenberg, Hooker, and Gray, in 1876 Barbey contributed a monograph of the Californian species to Brewer, Watson, and Gray's "Flora of California," and later published excellent figures of the new species which he there described. In 1884, Haussknecht published a there described. In 1004, riau-skinectit published a monograph of the whole genus Of the 53 species dealt with in Dr. Trelease's paper, 13 have been proposed by Haussknecht, 3 by Barbey, 4 by himself, and one by Parish, so that more than half the 38 have been lately described for the first time. Dr. Trelease describes fully all the species known in Temperate North America, gives an octavo plate of each of them, and a detailed account of their geographical distribution, cting the numbers of all the recent collectors. Of the 38 species only 9 extend their range beyond the American continent. The paper will be a very acceptable contribution to our knowledge will be a very acceptance controlution to our knowledge of a difficult genus, and will no doubt be incorporated in the new "Flora of North America," of which the second veglume is already published, and the first and third of which we anxiously wait for J. G. B.

A Guide Book to Books. Edited by E. B. Sargant and Bernhard Wishaw. (London Henry Frowde, 1891) THERE are so many books of all kinds that ordinary readers may be excused if they are sometimes at a loss as to the works which they ought to select for study. The editors of the present volume have come to the aid of such readers, and may be congratulated on the

manner in which they have accomplished a useful but most troublesome task. They make no attempt, in a philosophical sense, to classify the various subjects with which authors have dealt; they simply take these subjects one after the other, in alphabetical order, and set down what seem to them the best books relating to each. Taking into account the amount of space at their disposal they probably could not have chosen a plan that would have been more readily intelligible. Of course opinions will differ about the value of the works included in the several lists. Everyone who consults the volume will be of opinion that the editors have omitted some things which they ought to have noted, and that they have But there cannot but be a general agreement that, upon the whole, the selection has been made on sound principles, and that it is likely to be of real service to very many of those who may have occasion to refer to it. A large number of eminent writers have helped the editors, not only by drawing up lists of books, but by giving them much valuable advice.

Tasmanian Official Record, 1891 By R. M. Johnston, FLS By Authority Second Year of Issue (Tasmania, William T. Strutt, Government Printer, Hobart,

ANYONE who may wish to obtain information about Tasmania will be hard to please if he does not find what he wants in this elaborate volume. It begins with an account of the general physical outline of the island, and then we come to Tasmanian history, and to the Tasmanian constitution and government. After a chapter on Crown lands we are invited to consider the geology and mineral products of Tasmania, its flora and vegetable products, fauna and animal products, population, vital statistics, law, crime, and protection, and "intellectual and social provision" The work is wound up with a view of the proyress of Australasia, and a summary of general statistics. In the present issue some important additions have been made to the book as originally published, and by devoting attention to classification the editor has tried to "obviate any difficulties that might arise from the necessity of bringing together in one volume such a

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions ex-pressed by his correspondings. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other pair of NATURE. No notice is taken of anonymous communications.

The Albert University.

PROF. LANKESTER, in the interesting letter published in NATURE for May 28 last (p 76), expresses his desire to have 'a genuine professorial University set on foot in London, not because it is London, but because University and King's Colleges are there, and respectfully petition Her Majesty to do for them what the monarch has done in past days for other Universities '

Universaties."

I have not seen the petition of the Colleges. But I have before me the draft charter adopted by their Councils, which I presume Is insteaded to give effect to the prayer of the petition. I can hardly imagine that Frof. Lankester was acquisited with I for the present of the petition. I can bardly imagine that Frof. Lankester was acquisited with I fifth Albert University of London was in the theory of the petition of the petitio

NO. 1131, VOL. 44]

commending to its students systematic courses of teaching and methods of study." But "commending" is what we all do now.

all do now.

The new University is to be of the federal type Beginning with University and King's, "other Colleges may from time to time be admitted." This was inevitable, though my pointing out the fact made my friend Prof Laukester somewhat angry. out the fact made my friend Prof Laukester somewhat angry.

Any medical school may be admitted which is recognized as

efficient by any qualifying body under the Medical Acts. But
while Colleges will have representatives on the Council, the
medical schools will only have representatives on the Faculties

menuma scucous will only have representatives on the Faculties Degrees may be granted apparently in any subject the Council please, subject to a regular course of study and examination This will apparently admit theology, which is probably a desirable thing, provided it be unsectarian.

destrable thing, provided it be unacctarian.

The powers to grant degrees are rather large, and deserve careful consideration. The London radius at once, as has been the case with the existing University, goes of into Imperainfinity in the provision that anyone who has been a resident student in any University in the Empire may count his time and examinations, except that a "final portion of the period of study" and the "final examination" shall be passed in the

University. There is an unlimited power to grant ad eundem degrees as I nere is an unimited power to grant an unation degrees as well as honorary degrees at the discretion of the Council. Fellows of University and King's Colleges (a purely honorary distinction in itself) are indicated as fitting recipients, and also "past students of the said Colleges," a rather large door to open if in the future a degree is to have any meaning at all

Power is taken to examine into the efficiency of schools or any academic institutions-work already in the hands of other Universities-and apparently the London radius again becomes

Independent University lecturers may be appointed Independent University tecturers may be appointed
The Council will consist of members appointed for five
years by (1) the Crown (Lord President), (2) Convocation,
(3) Colleges; (4) Colleges of Physicians and Surgeons, (5)
Faculties
The Faculties are to be constituted (1) of teachers Faculties The Faculties are to be constituted (1) of teachers in the Colleges, (2) of examiners, (3) of persons who are or have been engaged in University teaching in London The Boards of Studies are delegations from the Faculties, as they should be. All this is much on the lines sketched out in my own letter in NATURE

A rather remarkable feature in the scheme is the creation of Convocation of graduates Whatever may be the function of this body in other Universities, it is somewhat surprising to meet with its existence in what profesions to be a teaching University

The examinations are to be conducted by examiners who a members of the respective faculties associated with external examiners, the teacher examiner seems not to be insisted upon These are the essential elements of the proposed constitution.

If it is asked what distinctive character the Albert University If it is asked what distinctive character the Albert University will possess which will mark it off from the existing University, or from that body as it might be conceivably reconstituted, I must confess that it seems to me to lie in a very small compass. Notwithstanding the use of the ambiguous word "commending." Notwithstanding the use of the ambiguous word "commending," when one would have expected "prescribing," I take it for granted that the essential feature in the whole scheme is the granted that the essential feature in the whole scheme is the enforcement upon candidates for degrees of attendance upon a curriculam. But in the existing University, this is already required in the Faculty of Medicine. Frof Husley has further urged it in the Faculty of Science, and for my part I believe that the time has arrived when it might be demanded without difficulty. The prominence given to practical work in the science examinations has made it all but impossible for a canscience examinations has made it an out impossion of a tended didate to acquit himself successfully who has not attended a competent course of instruction. To insist upon a currididate to acquit himself successfully who has not attended a competent course of instruction. To insat upon a curri-an competent course of instruction. To insat upon a curri-nuiton of this fact. The only real point of divergence as in miles of this fact, and the fact of the present of a curriculum is desirable; I am may be that the enforcement of a curriculum is desirable; I am the properties of the control of the control of the control of the execution, at I think it is in the Faculty of Scence With this execution I can see no not public gain in the new scheme to partly the creation of the cushroos machinery of a new federal University.

Seeing that the existing University is a State institution in actual possession of the field, I think the public at large might

have reasonably expected from the Senate some statesmanlike criticism, rising above the petty level of supposed self-interest in the very serious action which the Government is apparently about to take

197

to take. They content themselves, however, with a sort of half sulky acquisesome in the scheme "so far as it proposes to confer on the pertonage College the power of grauming digrees in a sure that the scheme of placing the power of granting degrees in the hands of those naturally insists upon the inconsistency with this position of the proposal "to accept resistence and examinations at other un-versities," if only a final period of study, "which might be a short attendance at evening classes," be passed at the new University It also objects to the honorary and ad cundem degrees But

It also objects to the honorary and ad candem degrees. But its criticism is even more destructive in regard to the Medical Schools. It is quite obvious that if the Medical Schools joined the Albert University, the teacher-examiner system would disappear, and the new and the old Universities would be simply competing agencies for doing the same kind of work in the same kind of way The same argument applies more or less to the other faculties as soon as the number of constituent Colleges becomes numerous

Yet so great is the magic of a phrase that the daily papers in reporting the proceeding, in the Privy Council describe the scheme as that of a Teaching University A University of the Scotch or German type may have some claim to that title, but no federal University can ever possess a valid one, for the simple reason that there will always be a morphological distinction between the Colleges which teach and the University which

examines and grants degrees
Prof Lankester contended in his letter that the question whether University and King's Colleges should have a University Charter was a sort of private affair between them and the Govern nient But I do not think this view can be accepted ment but I do not taink this view can be accepted whether we like degrees or whether we do not, they have a certain value in the eyes of the public Personally, I have no objection to the multiplication of Universities, if each has a proper geographical area assigned to it. But the multiplication of Universities in the same place seems to me a great evil It cannot be assented to without the necessity heing shown to be overwhelming. in the present case it appears to me that it cannot be so shown If the existing University is so injurious to the best interests of the higher education that another is imperatively demanded to do the work in which it fails, then it appears to me that two obvious points pre-ent themselves —

(i) The new University should be free from the defects that

attach to the old one Prof Lankester speaks of the "thraldon" of "the Imperial centralizing institution", but when the matter comes to be looked into, the new institution also proposes to be Imperial and centralizing, and will be found to exercise the same or even greater thraldon on the individual teacher

(2) If the old University is really doing mischef, it is the paramount duty of the supreme Government, whose creature it is, to reform it. The fact that the Senate and Convocation are to reform it The fact that the Senate and Convocation are at loggerheads how this is to be effected is really beside the When public opinion demanded the reform of the older Universities, new ones were not created alongside the unreformed old ones, but a Commission with executive powers reformed old ones, but a Commission. And for a simil effected the changes which were necessary. And for a simil procedure there is still time at Burlington Gardens.

W. T. THISELTON-DYER. And for a similar

Royal Gardens, Kew, June 30

The Holarcuc Region

RFYLEWING the recently published "lattroduction to the Study of Mammals" by Prof. Flower and Mr. Lydekker, Prof. Landester state (gryd, p. 12) Jahn. "The nuthors of the present Landester state (gryd, p. 12) Jahn." The nuthors of the present Nearctic regions should be united and called the Flohrect region. But they do not adopt this opinion, nor refer to Hude'y proposal to term this same area. Arctogras," and so on. Now, is this last statement my good friend the reviewer, perhaps willing from memory, is mistaken. Had Irof. Hude'y proposed to Inteln this "Arctogras" to the Falsaractic and

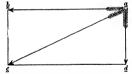
Nearctic regions of Mr. Sclater and Mr. Wallace, I should certainly not have suggested to Prof. Helipme a new name for that combination. Anyone booking. On the prof. Helipme a new name for Mringle (defined his "Arctogea."—a name to which, let me say, I have not the least objection—will see that it signifies that part of the world which is not "Notogea," and therefore includes the Ethiopian and Indian regions of Mr. Solter, whereas my "Holascic." region expressly excludes them, and is therefore a very different thing from "Arctogrea" in its true sense.

ALFRED NEWTON. Magdalene College, Cambridge, June 12.

Force and Determinism,

In your issue of March 12 (vol alin p 491), Dr. Oliver J lay your issue of March 12 (vol altin p 401), Dr. Oliver J Logic characteries as "perfectly corrected to streement "that, logic characteries as "perfectly corrected to the content of matter, none is needed to alter its direction." I have looked in vain for some notice of this apparently strange doctrime in your subsequent issues, with the exception that Frof C. Lloyd Morgan (April 16, p. 58) objects that the direction of motion only the observation of the content of the motion of the content of t

ncrease the speed of matter ". But, as a matter of fact, is it not very difficult, in not indeed practiculty impossible, to change the direction of a moving body without affecting its speed? "A force at right angles to motion does no work," says Dr. Lodge Let us examine this statement for a moment. Let a body be moving in the direction a to 8 with a speed sufficient to traverse the distances in one unit of time. Then let a force be applied to



the body at a, at right angles to the direction of its motion, the body at a, at right angles to the direction of its motion, sufficient, if accurage alone, to carry the body to of an the same unit of the unit of time, would, therefore, be found at c. But the distance at a greater than ab, and as, by the interposition of a force at right angles to its motion, the body has thus inversed a force at right angles to its motion, the body has thus inversed as of fact, been increased a fand in on this increase of peed actual work? and does not this work require actual energy to perform at 10 works IIS A lives.

EVAN MCLENIAN.

Brooklyn, Iowa, U S.A , June 9.

I AM glad to see my statement called in question, and hoped that it would have aroused more antagonism than has yet been expressed; because I do believe that it has important psycho-logical or metaphysical consequences, and should therefore either be repudiated by physicists or after due discussion be accepted by non physicuts.

With regard to the special objection raised by Mr. McLenns

With regard to the special objection ranged by art, melannam, it may be sufficient to remark that, in his diagram, at is the line of motion, ad the direction of the force, and that ad is not at right angles to ac. His difficulty seems to be the one that some people always feel with regard to the use of infinitesimals in general. He must remember that his diagram will not apply

to the case of curvilinear motion unless the impulses contemplated are momentary and infinitesimal. OLIVER J. LODGE

The Scorpions at the Zoo.

YOUR contributor of the notice, published in NATURE on June 18 (p. 163), on the contents of the Insect-house at the Zoo, who laments the unfortunate circumstance that the scorpions there in captivity remain unnamed, may be glad to learn that these creatures may be easily identified, and, with a little dex-terity, fearlessly handled

During a recent visit to this house, the keeper obligingly showed me the two Egyptian scorpions, one of which—the black individual with the thick tail—was easily recognizable as Prionurus crassicauda, Oliv., a tolerably common North

African and Syrian form

Afracan and Syram form 1 could not so readily assign a name; 1 to the other, however, 1 could not so readily assign a name; 1 to the other, however, 1 could not so readily assign a name; 1 to the country of the count

qualitying for incarceration in Biolians, fastily interposed when Larteched out my hand to pick up the noxious animal. The third scorpion I did not see, but doubtless it is a fast to be a seed of the seed of t another genus is before them

another genus as before them In conclusion, some of your readers may be interested to know that the spider referred to as Lyona portosantana—which, by the way, should be styled Tarantula mader ana—is a very near ally of the famous and historical Tarantula of Italy, and that the harry Brazilian monster, the so-called Mygsle, who squats under a broken flower-pot in the next cage, has no more claim to the title Tarantula than any other Arachnoid with a formid-R I. Pocock

Natural History Museum, June 18

Cetaceans in African Lakes,

Wirst reference to Mr. Schter's inquiry (NATURE, June 11, 124) as to the occurrence of porposas in the Victiona Nyanza, the following extract from Bernier, who wrote about 230 years ago, will probably prove of inteest

I may add that in another passage Bernier gives further in formation regarding the sources of the Nile

It would seem from the passage quoted that the occurrence of At WOURD SCHOLLING THE PRESSAGE QUOTED that the occurrence of a Cetacean in the Abysinian sources of the Nile was probably known to early travellers, and, like the occurrence of chamonds in other parts of Africa, cannot be regarded as a new discovery Science and Art Museum, Dublin, June 22.

V. BALL

Science and Art Museum, Dublin, June 22. V. BALL.

An Armenian anned Muriat and a Mogul who came as ambassidors from the Christian King of Ethiopia (i.e. Abysinils).

An Armenian anned Muriat and a Mogul who came as ambassidors from the Christian King of Ethiopia (i.e. Abysinils).

An Armenian anned Muriat and the Armenian anneal an were remains mets, note of erocoultes, and twantowhold be remarked belle enough of treat, abundance of sea calves, that have no other word, Gre, than that by which they take in their food, this lake being in the country of Dambea, three small days' journey from Gundar and four or five days' journey from the source of the Nile, de, de. "(" "The History of the Empire of the Mogul," English translation of 1684, p 44).

ON SOME POINTS IN THE EARLY HISTORY
OF ASTRONOMY

V.

It is imperative to be perfectly definite and clear on the question of the amplitudes above 20° at Thebes. Any amplitude within 26° means that up to that point the sun at surners or sunset could be observed some day or days of the year—once only in the year if the amplitude is exactly but the case of these temples with greater amplitudes than 26°, it is quite clear that they can have had nothing to do with the sun. Is there, then, any additional line of evidence that the Egyptians used these temples to observe a temple but at one period to observe a star could not go on for ever serving its purpose, for the reason that the declination of the star must change by precession Therefore a temple but with a particular amplitude to observe a particular star, useful for one period would be

We have here possibly a means of testing whether or on any of these temples were used to observe the stars in those very early days, 5000 or 4000 years it.C., we must assume that the people who observed the stars had not the slightest idea of these possible precessional changes; they magned, that they were just a safe in directing a temple to a star as they were in directing a temple to the sun but with a star changing its declination in an average way, the same temple could not be used to observe the end of that time, I they still wheel for a sheet that the truther star, they must either change the axis of the old temple, or build a new one

As a matter of fact, we find that the axes of the temples have been changed and have been freely changed, that there has been a great deal of work done on many of these temples which are not oriented to the sun, in order to give them a twist

Once a solar temple a solar temple for thousands of

Once a solar temple a solar temple for thousands of years; once a star temple only that star temple for something like 300 years, so that the conditions were entirely changed

We get cases in which the axis of a temple has had its direction changed, and others in which, where it has been difficult or impossible to make the change in a temple, the change of ampitude has been met by putting up a such temple as a series in which instead of changing the orientation of a pre-existing temple, a new temple has been built to meet the new condition of things. That, think, it as suggestion which we are justified in making to

Egyptologists on astronomical grounds
We cannot, of course, make it with absolute certainty, for the reason that in the case of most of these temples the best Egyptologists cannot give us the most precious piece of information which we require from the astronomical point of view. That is the date of the foundation of the temple. If in the case of these temples it were absolutely certain that each temple was built at a certain time with a certain orientation, the use of the precessional globe would tell us at once whether or not that temple was pointed to any particular star. Some other astronomical considerations may here come to our help. If the north polar distance of a star is increasing-that is, if it is increasing its distance from the north pole-its declination is being reduced, and the orientation of the temple would be gradually becoming more and more parallel to the equator; if the declination of the star be increasing, then the orientation of the temple would have had to be more and more north or south The change in the orientation, therefore, could give us important

' Continued from p 110

information, and ultimately we might be able to determine what the name of that particular siar was. At present the matter must remain more or less as a suggestion; but if anything like approximate dates can be given, then astronomy really may come to the rescue of the Egyptologist and archæologist generally, and repay that deb to which I have referred, which she owes to so many other

Although, however, these matters can be discussed in a way that will indicate that the inquiry is raised, I do not wish for one moment to speak of it as being settled, because the observations which have been made already in Egypt with regard to the orientation of these temples have not been made from such a very special point of view; and further some alteration in the amplitude would be made by the presence of even a low range of hills miles away from Thebes in the case of a star mange or setting pretty menty north or south. No



Fig. 14 -The two temples at Medinet Abos, showing the change in their

one would care to make the assertion with absolute definiteness until a was known whether on not the horizon in each case was interfered with by hills or any intervening objects—was or was not one, in fact, which might be regarded as a sea horizon from the point of observation; if there were impediments, the angular height of them must, of course, be exactly known.

To continue this observation and this kind of thought

To continue this observation and this kind of thought a little further, we will go back to Karnak generally. In the first place we have the magnificent solar temple.

Next we have two parallel temples, one of them a late addition to the solar temple itself, and another one parallel to it, each of them with an amplitude of 63°, one N. of E., the other S of W We have then two parallel temples at right angles to the solar temple at Karnak We have also a temple, with an azimuth of 68° N, of E., and one, probably older still, with an amplitude of 8° N, of E., and one, probably older still, with an amplitude of the solar parallel temples at right and the solar parallel temples, one of them is a simple to the solar parallel temples, one of them is a late of 50° N. of E., and one, probably older still, with an amplitude of the solar parallel temples, one of them is a late of 50° N. of E., and one, probably older still, with an amplitude of 50° N. of E., and one, probably older still, with an amplitude of 50° N. of E., and one, probably older still, with an amplitude of 50° N. of E., and one, probably older still, with an amplitude of 50° N. of E., and one, probably older still, with an amplitude of 50° N. of E., and one, probably older still, with an amplitude of 50° N. of E., and one, probably older still, with an amplitude of 50° N. of E., and one, probably older still, with an amplitude of 50° N. of E., and one, probably older still, with an amplitude of 50° N. of E., and one probably older still, with an amplitude of 50° N. of E., and one probably older still, with a manife of 50° N. of E., and one probably older still, with an amplitude of 50° N. of E., and one probably older still, with a manife of 50° N. of E., and one probably older still, with a manife of 50° N. of E., and one probably older still, with a manife of 50° N. of E., and one probably older still, with a manife of 50° N. of E., and one probably older still, with a manife of 50° N. of E., and one probably older still, with a manife of 50° N. of E., and one probably older still, with a manife of 50° N. of E., and one probably older still, with a manife of 50° N. of E., and one probably older still, with a manife of

tude of 70° or 71° N of E; both these temples face norberly, and nearly in the same direction. Near the last temple we have the runs of another one at night angles to the difference of the points so the received and plan of the runs that the Naos 1s at the east end of the temple, therefore the chief plyon would have been to the west, and therefore the axis will be in that direction, the state of the contraction of the truns that the Naos 1s at the east end of the temple, therefore the chief plyon would have been to the west, and therefore the axis will be in that direction, the state of the temple of the truns that the Naos 1s will be in that direction, the property of the temple of Maist and Karnak, the line is absolutely complete as far as their bases are concerned, with the exception of two where there is a gap, and that gap is exactly in the axis of this temple prolonged. Here is another being strictly reserved.

The Egyptians have been accused of hating every regular figure, and even in the boundary walls of the temple of Ammon there are two obtuse angles Rousel had the Maut temple we also have walls, and there again this hatred of anmiarry seems to come out, for we have a little carefully, we find that there is a good deal of method in this apparent irregularity. The wall of the temple of Ammon is parallel to the face of the temple of Ammon is parallel to the face of the temple angles to the sphinnes. And the reason that we do not get right angles at one end of the wall is that the walls of the temple of Ammon. Surely it must be that, before these accombined worthing, that they stood or fell together. One thing was not attempted in one temple and another thing in another, but the worthin of sach was reflected in the other. Am of this bettue you see that there was

We can depend, and no doubt depend very completely indeed upon the labours of the Egyptologists, in the case of the temples of Ramsess and of Khons No Egyptologists of Egyptologists, in the case of the town of

Was there an important star with a declination of 53° N, m, was there another with a declination of 53° N, in the year 1200 BC.? There were two important stars, one with a declination of 53° N, and another of 53° S, at that time The north star was p Dracons, the south star was Canopus This strengthens the view that there was really some astronomical object in the plan and direction of these temples

Thus, at the time when these two temples were stated to have been built, each might have been suited to observe one the raing, the other the setting, of an important star. We have long ago seen that so far the Egyptians, like the Babylonians at a later date, only had an idea of observing a heavenly body and the position of other bodies in relation to it, so long as it was raing or settings, so that it was absolutely essential that the body which they were to observe should rise and set. You know perfectly well that in London there are many being \$1°, the elevation of the pole therefore a \$1°, and from the pole to the north point of the borron being \$1°.

of course any star which lies at that distance from the pole eannot set, but sweeps round without touching the horizon at all. The latitude of Thebes being 25°, the distance from the pole to the horizon is much smaller, and so the number of stars which do not rise and set is much smaller. The stars which did not rise or set were stars which were moving very slowly and the stars which rose most to the north and most to the south were those nost to the north and most to the south were those bodies which were moving most slowly while they yet rose or set Can this slow rate of motion have bad anything to do with such stars being selected for observation, the brightest star to the north, most slowly moving, the brightest star to the south most slowly moving? It is possible that observations of these stars might have been made in such a way that at the beginning of the evening the particular position of γ Draconis might have been noted with regard to the pole star, if there were no other reason, and seeing that the Egyptians thoroughly knew the length of the night and of the day in the different portions of the year, they could at once the moment they got the starting point of the rising of this star practically use the circle of the stars round the north pole as the dial of a sort of celestial clock May not this really have diat of a sort of celestral clock way not this really have been the clock with which they have been credited? However long or short the day, the star which was at first above the pole star, after it had got round so that it was on a level with it, would have gone through a quarter of its revolution

So much then for the possible use of the temples built by Ramess III in the year 1200 in C I has already been pointed out that although we have in one an amplitude of 65 N of E we have other temples with amplitude of 65 N of E, and 71 N of E. Everybody agrees that the temple, with amplitude 69 N of E, was built 1200 years in C. I have shown that that temple could have shown that that temple could have a transfer of the temple and the 71 temple were temples built to observe the same star the fort this one was built, because we know they could not have observed the star after this one was built, since y Draconis us december 18 declination, therefore in previous times its declination would have been higher, and the amplitude therefore of a temple to observe it would have been

Looking back to the German tables and other calculations, we find that with an amplitude of 65° we get a declination of 56°, and the same tables tell us that that declination of 50°, are the same tables are y Draconis 2000 years BC I tools look as if in all probability we are dealing with a series of temples not twisted

but bulk in different places.

Can we consider that the temple with an amplitude of 71° might have been used to observe that same star long before the temples were bulk with amplitudes of 68° and 63°? The amplitude of 71° gives us a declination of 68° and 64°? The amplitude of 71° gives us a declination of 80° and 64°? The amplitude of 71° gives us a declination of 80° and 64° an

The discussion is a little difficult because the orientation is very far towards the south and north, and therefore a hill a few miles off would make a difference of 2° or 3° in the orientation of the temple, and as yet we have no observations that throw light on this point. We have then at Tbebes alone three converging lines

We have then at Tbebes alone three converging lines of evidence which all go to strengthen the view that these temples were really—whatever else they might have been —usable as solar and stellar observatories. The difference being of course that in the case of the solar temple no large change of amplitude was necessary, but that in the case of every stellar temple after a lapse of a certain number of years depending upon the position of the star, the temple must be twisted round if it were wished to

continue to make observations of the same star. That raises an interesting question by the way. Long after the temple had been used for observation of a particular star, long after that temple line was blocked by extended building, if the horizon of these temples was left open it looks very much as if when another bright star came along it was laid hold of for a new set of observations. However that may be, it is rendered extremely probable, by the considerations I have brought before you, that the Egyptians 3000 years B C had been rendered practically conversant with the result of the precession of the equinoxes by the fact that they had to rebuild and alter their temples from time to time because the stars changed their declination If that he confirmed by subsequent investigations. it will show that these Egyptians possessed a very much more profound knowledge of astronomy than they have received credit for, because it is stated that the precession of the equinoxes was discovered by Hipparchus. It looks as if the precession of the equinoxes was probably published by Hipparchus as the result of an examination of the untold wealth of Egyptian astronomical observations which has been unfortunately lost to the world

This question of orientation is after all one which survives among ourselves All our churches are more or less oriented, which is a remnant of old sun worship, and the church is not always oriented exactly to the east, but so that the light of the sunrising upon the Saint's day to whom the church is dedicated may be thrown along the chancel

It has long been known that Stonehenge is oriented to the rising of the sun at the summer solstice. Its amplitude instead of being 26' is 40'; with a latitude of 51', the 26° azimuth of Thebes is represented by an azimuth of

40° at Stonehenge

The first of January is very near the winter solstice, but is not quite the winter solstice lf you look up the old records of the races that lived 2000 or 3000 years B.C., you will find that the different races began their year at different times, and even that the same race at different times began their year differently, the choice lay among the equinoxes and the solstices, and seeing that one of the very oldest temples at Thebes is oriented to sunset at the summer solstice we should not be at all surprised if investigation shows that when that temple was built more than 3000 years B C., the Egyptian year really began in what we should call our summer We have ample evidence of this And I think there is little doubt that when Stonehenge was built it certainly was built by people who began their year with the summer solstice, which you will remember is the time of the year in which in many countries it is the habit still to light fires upon hills and so on

The next point is, what was probably the use made of these temples besides determining the length of the year and regulating so far as they could the seasonal changes, the times of the solstices, the times of the equinoxes, and

the various celestial phenomena?
We understand that in the very beginning of observations in all countries, the moment man began to observe anything, we saw that he began to observe the stars, and the moment men began to talk about anything they had seen they must have started by in some way or

other defining the particular stars they meant.

They would obviously talk first of the brightest stars, and separate them from the dimmest ones, they would then discuss the stars which never set, and separate them from those which did rise and set; then they would take the most striking configurations, whether large or small; they would choose out the constellation of Orion or the Great Bear, and for small groups the Pleiades' These

would attract attention, and be named before anything else Then later on it would be imperative in order to connect their solar with their stellar observations that they should name the stars which lay along the sun's path in the heavens. They would confine their attention to a belt round the equator rather than consider the configuneit round the equator rather than consider the configu-ration of stars half-way between the equator and north pole. In all countries—India, China, Babylonia, Chaldeza, Egypt—they had a sort of girdle round the heavens, called by different names in different countries, and the use of this girdle of stars, which sometimes consisted of twenty-eight stations, sometimes of twenty-seven, and sometimes of only ten, was to enable them to define the place of the moon or of any of the planets in relation to any of these stars That condition of things, that stage of thought, is brought well before us in the lewish

In the Book of Job we read, "Canst thou bind the sweet influences of Pleiades, or loose the bands of Orion? Canst thou bring forth Mazzaroth in his season? or canst

thou guide Arcturus with his sons?

Here we have the difficulty which has met everybody in going back into these old records, because there was no absolute necessity for a common language at the time . it was open to everyone to call the stars any name they chose in any country, therefore it is difficult for scholars to find out what particular stars or constellations were meant by any particular words. In the revised version, Arcturus has given place to the Bear with its train, and even our most distinguished scholars do not know what Mazzaroth means I wrote to I'rof Robertson Smith the other day to ask him to give us the benefit of his great knowledge, and he says that Mazzaroth is probably that band of stars round the ecliptic or round the equator to which I have referred, but he will only commit himself to the statement that it is a probable enough conjecture, other people believe that it was a reference to the Milky

I mention this to show you how very difficult this inquiry really is The "seven stars" undoubtedly mean the Pleiades and not the Great Bear Among the brighter stars, Arcturus, the Plejades, &c , are referred to by Homer and still earlier writers So far as Egyptian and Chinese astronomy goes, practically the first reference to a constellation appears in Egypt with reference to the equinox which happened 3285 years BC, and in China with reference to the Pleiades in the equinox of 2357 B.C.

In observing stars nowadays, we use a transit circle which is carried round by the earth so as to pick up the stars in different circles round the axis of the earth prolonged, and by altering the inclination of the telescope of this instrument we can first get a circle of one declination

and then a circle of another

The Egyptians did not usually employ mendian observations. Did the Egyptians make star maps? They certainly
did In the temple of Denderah, which is a comparatively modern temple, there is a very precious series of records which is certainly not at all modern. It represents a good many of the Egyptian constellations. The central part was in all probability the zenith point of Denderah itself, and at a certain distance from the centre point we have the zodiac represented excentrically. constellations round the edge are those nearest the horizon; the central ones are those nearest the north pole; instead of having the Great Bear, we have the constellation of the Thigh, representing the well-known seven stars; in addition we have the constellation Hippopotamus, which has now entirely disappeared. There is also a Babylonian zodiac, which will show you that, although Babylonia and Egypt were adjacent countries, yet that they had a perfectly different set of constellations. Our present constellations came not from Egyptian times, but from much later—from Greek times. It is almost impossible to hope to recover the names of the

constellations used by people earlier than the Greeks, but still much is to be hoped from the study of the Babylonian records In these we have a snall being drawn along by the tail of a snake or dragon. It is quite possible that we may have there the origin of our constellation Draco, which is the northern constellation, and it is quite possible that this snail may indicate that the stars in it moved with very great slowness. But it is impossible at present to co-ordinate these different fancies together

A very important paper has recently been published by Mr. Le Page Renouf suggesting that before the year 1500 B.C. the Egyptians really had an idea of meridional observations. These observations are recorded in several manuscripts found in tombs; they seem to have been given as a sort of charm to the people who were buried in order to enable them to get through the difficulties of

the way in the nether world

The hieroglyphs state that a particular star of a particular Egyptian constellation is seen at a particular hour of the night, we have twelve lines representing the twelve hours of the night, and it is stated that we have in these vertical lines the equivalent of the lines in our transit "over the right eye," "over the life shoulder," or "over the left ear," as the case may be, is simply a reference to the position of the star

If this should be confirmed, one of the remarkable things about the inquiry will be that the Egyptians did not hesitate to make a constellation cover very nearly oo In those days evidently they wished to have as few constellations including as many stars as possible, in order

perhaps that things might be more easily remembered
When the zodiac of Denderah was mentioned. I pointed out the constellation of the Hippopotamus very near the north pole. This constellation is referred to in the records

in question

Such then are some of the ideas which are suggested by the recent work of the Fgyptologists You see, I trust, that it is important that this work should be continued as closely associated as possible with astronomical ideas, because, merely taking a very small part of the area of which they have begun the consideration, we have come to the conclusion that, dealing with the temples alone, there seems a very high probability that 3000, and possibly 4000 BC the Egyptians had among them men with some knowledge of astronomy, and that 6000 years ago the course of the sun through the year was practically very well known, and methods had been invented by means of which it might in time be better known, and that not very long after that they not only considered questions relating to the sun, but began to take up other questions relating to the positions and the movements of the stars. It is quite probable that 1500 years B.C. at least they had an idea of meridional observations If this be so, and if more and more can be proved, I think you will agree that, as I said before, astronomy will have a slight opportunity of repaying some of the great debt which she owes to the other sciences

I NORMAN LOCKYER

THE LATER LARVAL DEVELOPMENT OF AMPHIOXUS

THE memoir by Mr. Arthur Willey, B Sc , of University College, London, on this subject, in the Quart fours. Microsc Science, March 1891, deserves more than a passing notice. It is one of the most important contributions which have been made to a knowledge of this very interesting animal In the summer of 1889, Mr Willey was sent by Prof Ray Lankester with the aid of a Government grant to collect the larvæ and embryos of Amphioxus at Faro, near Messina He returned with a large series, and in the winter 1889-90 worke I out in the laboratory of

University College, chiefly by means of sections, the history of the formation of the atrial cavity in this animal. In a paper published jointly by Prof. Lankester and Mr. Willey (Quart. Journ Micr Sa, August 1890), it was shown that the atrial cavity does not form, as supposed by Kowalewsky and by Rolph, as the result of a down-growth of lateral epipleura, but that it forms as a longitudinal groove which sinks inwards along the ventral surface, becoming floored in by a small horizontal growth on each side corresponding merely to that portion of the adult animal's ventral surface which lies between the two metapleura. The groove, now become a narrow tube, expands right and left, until it acquires the proportions of the adult atrial chamber

The preserved material brought home by Mr. Willey in 1889 did not enable the observers to determine the mode of origin of the second row of gill-slits Stages were noted in which there were as many as fourteen gill-slits of the first series (which are placed anteriorly on the animal's right side), and stages were observed, of no greater size, in which two rows of gill-slits were presentone series on the right side and one on the left side of the pharynx, whilst the mouth, which in the specimens with a single series was completely lateral (on the left side),

had now taken up a median position

Mr. Willey again visited Faro in the summer of 1890, for the purpose of determining, by the study of living transparent larva, exactly the mode of origin of the second row of slits, and the steps in the "symmetrization" of the The brief account and few unconvincing figures given by Kowalewsky, in 1866, in relation to this matter had not commanded general confidence, although it was not hat so accurate and accomplished an observer could not have been completely mistaken. Balfour had said, in reference to Kowalewsky's observations on this matter,

that he was "tempted to suppose that his observations were made on pathological specimens"

Mr Willey completely and most successfully accomplished the object which he set before himself in his second visit to Faio, and the results obtained are given in the paper under notice, illustrated by three folding-plates He confirmed the main feature of Kowalewsky's observations, viz that the first row of gill-slits, after having (so far as the first eight are concerned) taken up a position on the right side of the pharynx, rotate downwards across the median ventral line, and rise up into position on the left side, whilst, simultaneously, a new series appears on the right side, not one by one, but as many as six being formed at approximately the same moment Mr Willey corrects Kowalewsky's brief ac count in one or two numerical details, and adds some very important facts, which are quite new. He shows. (a) that the anteriormost slit of the primary series closes up and disappears during the process of rotation; (b) that some of the hinder slits of this series, which are not far advanced when the rotation begins (there being usually fourteen, of which the last six are very small, and lie in the median ventral line), also close up, so that, when the rotation is complete, and the second series of gill-slits has advanced in development to the number of eight, a "critical phase" is reached in which there are only eight gill slits on each side of the pharynx, all fairly well developed From this time forward new gill-slits are formed on each side behind the last formed, and continue to increase in number so long as growth continues, which appears to be as long as the Amphioxus lives

But the most important discovery made by Mr. Willey is as to the origin of the endostyle, a structure which has great importance from the fact that it can be clearly identified, on account of its minute histological structure, with the endostyle of the Ascidians.

In the anterior region of the buccal cavity, previous observers have described in very young Amphioxus larvæ (with only one gill-shi) an elongated gland; "the clubshaped gland." It opens to the exterior on the left side, just in front of the by laterally-placed mouth, whence it can be traced, bending down across the median line and passing up a regist angle is the long axis of the body along the deep surface of the right wall of the buccal into the local carry. It is earliest appearance (as described by Hatschiel) resembles that of a gill-slit, though it precedes both the mouth and the first gill slit in date Mr. Willey suggests that it is a modined gill-slit. By the said of this chulls shaped glan band like trace of modified

but the <-shaped epithelial tract does not; it grows rapidly at its angle along the line or interspace between the two series of slits, forming a double tract of modified epithelium consisting of parallel extensions of the two limbs of the <- It is now the epithelium of the hypolimbs of the <- It is now the epithelium of the hypo-

202

epithenum consisting or parallel extensions of the two inthis of the 4.7. It is now the epithelium of the hypopharynged indge or endotyle pharynged indge or endotyle specially the first shaped gland so intimately associated with the first shapes of the endotyle as a modified gli-slit belonging to the secondary (the permanent right-side series). Its early development in front of the mouth indicates this, since, when the mouth acquires a modal no postion (lassing front the left towards

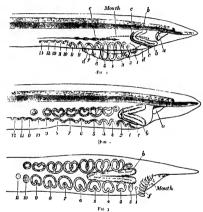


Fig. 2, 2, 2 Degrees showing time trains in the development of the gill also and solveyly of Amphonius. Sur. 1 ved 2 are seen from the right act, Fig. 5 me to be toward appear in 1 me observable proper in the same, are indented by a footed over 1. The primary series of gill also are numbered in all the figure. The secondary series are not on the right which are the three of the same of the secondary series are not be right while, at the same time the secondary series have developed in the number of calculation of the secondary primary primary primary primary and in graining its angie between the two rows of galactic 3 me indicated by a continuous continuous and a graining its angie between the two rows of galactic 3 me indicated any comment of the secondary series are developed as the number of calculation of the contraction of the secondary continuous and the secondary developed and the secondary continuous and the secondary developed tract of pharysgeal region), c, then at thicknesses which develop the an anterior gill six of the secondary genument right index senses. f, the present incomment.

intra-buccal eputhelium. When there are about eight gill-slits of the primary series present, it is noticeable that the apex of the club-shaped gland is bent over, so that the gland teads to become -shaped, with the angle effects of the club-shaped gland is bent over, so that of the club-shaped gland to be the club-shaped gland to be proper limb of the
- It is a good det is smaller than the lower, but as the primary series of gill-slits move from the right side of the praym; to the left, the two humbs of the
- Secondary series of gill-slits move from the right side of the between the primary and the new secondary series of sits. The club-shaped gland-tube now arophies entirely,

the right by a relative growth, the reverse of that which brings the primary gill slits from the right to the left ly, structures just in front of it would be thrown round to the right side, the side of the secondary series of silts. He suggests that it is the early-developed auterior member of the secondary series of gill-sits; and points out that just as this modified gill-slit atrophies, so does its pair in

the primary series, viz. the first.

Mr. Willey points out the possible importance of these facts in reference to the views of Dohrn and of Van Beneden, and makes an interesting comparison between the Ascidian tadpole and the Amphioxus larva, with a

view to suggesting some explanation of the extraordinary asymmetry of the latter. Mr. Willey thinks that a cause of the one sided position of the mouth and of the primary series of gill-slits in the Amphioxus larva may be found in the excessive anterior prolongation of the notochord at an early period of development, necessitating a pushing to either one side or the other of the mouth There appears to be nothing in the mode of life of the larvaa free-swimming ciliated creature-which can be correlated with its asymmetry. The gradual process of "symmetrization," by which the Amphioxus establishes more or less completely a bilateral symmetry on its way to the adult form, is exactly the converse of that process by which the symmetrical larva of the Pleuronectid fishes becomes one-sided, but in the latter case the asymmetry is clearly correlated with a peculiar life on the sea bottom, whilst in the former case we can discover no such relation to environment.

THE CARDIFF MEETING OF THE BRITISH ASSUCIATION

To arrange for the reception of the members of the British Association who will visit Cardiff in August next, an influential Local Committee has been formed. with the Most Honourable the Marquis of Bute, K.T., Mayor of Cardiff, as Chairman, and a substantial sum has been subscribed for the purpose of defraying the cost of the meeting.

Several sub committees have been formed, all of which report to the Executive Committee, to which also the Council of the British Association has assigned the duty of electing new members and associates Up to the pre-sent time 7 life members have been added, and over 200 annual members and associates, and as the time for the meeting approaches the number of new members and associates will be largely increased

It may be convenient to describe what has been done by the sub-committees, so as to give a systematic account of the preparations already made and in progress to provide for the comfort and entertainment of our expected

visitors

(1) Hospitality and Lodgings — Many of the principal residents in Cardiff and the neighbourhood have signified to the Committee their desire to entertain members of the Association, and as the date of the meeting draws nearer numerous additional offers will be made by those of the townsmen who are unwilling or unable to fix their en-gagements so long beforehand It is understood that those ladies and gentlemen who have offered to invite guests will send out invitations as soon as it is known to the Committee who are coming.

The hotel and lodging accommodation is not so great as in some other towns, but the Committee feel sure that with the private hospitality which will be offered there will be enough for the needs of our visitors. The list will be enough for the needs of our visitors. The list of hotels and lodgings will be ready for distribution about the middle of July, it having been delayed to make the list as complete as possible. The list will be accompanied by a map of Cardiff taken from the most recently

executed ones.

(2) Reception and Section Rooms - The reception room will be at the Town Hall, practically the whole of which has been placed at the disposal of the Local Committee for the use of the Association The vestibule will be devoted to the sale of tickets, the distribution of pro rammes, and other information, whilst the Assembly Rooms will be fitted up as a drawing-room with writing-tables, post-office facilities, and a book-stall The Council, Committee of Recommendations, and General Committee will meet in various rooms, and others will be set apart for the officers of the Association.

As the Town Hall is about half a mile from the Section room furthest away, a portion of the Drill Hall, the use of which has been kindly granted by Lord Bute, Colonel Gaskell, and Colonel Page, will be fitted up as a drawingroom, and the remainder will be used as a luncheon-room. As the Drill Hall is situated within very easy distance of almost all the Section rooms, the members of the Association will doubtless appreciate the advantage of having a drawing-room and dining-room so close at hand.

The majority of the Section rooms are very close to-gether, and the greatest distance is not more than half a between the extreme points, so that even that distance should offer no difficulty in the way of members wishing to attend different Sections

(3) Entertainments,-The usual conversazioni will be given on Thursday, August 20, and on Tuesday, the 25th, and it is hoped that scientific men will aid the Committee in contributing towards the entertainment of our guests by the exhibition of novel experiments or specimens. The Park Hall, in which the conversations will be held, is well suited to this purpose, and it is the desire of the Committee to introduce as many scientific novelties as possible

A garden party, to which all members of the Association will be invited, will be given by Lord and Lady Bute, probably on the Friday afternoon, though the date may be subject to alteration. Other social entertainments Other social entertainments are projected by Lord Windsor and others, and Cardiff will probably in this respect not fall behind what the members have been accustomed to at other places of

meeting.

(4) Encursions —A considerable variety of excursions has been provided for both the Saturday and the following Thursday For the former, arrangements are being made by Sir W T Lewis for a party of members to visit the Cardiff Docks, by a committee appointed by the Board of Directors to visit the Barry Docks, by the Mayor of Newport and the Chamber of Commerce for a party to visit Newport and Caerleon A special excursion is being arranged by the Colonel commanding the Severn Valley division of submarine miners for officers of the British Army to inspect the Severn Valley defences. The Army to inspect the Severi vary account of the steep and flat holmes, and will continue with the civilians on board to Weston, from which they will visit Worlebury Hill and camp.

Other excursions will be of geological and archæological interest, and will include excursions to Penarth and Lavernock, where the finest section of Rhatic beds in England is exposed; to the interesting dolmens at St. Nicholas and St Lythan's; to Llantwit-major, where a year or two ago the remains of a Roman villa were unearthed, and where a college is said to have existed in the fourth century, to Tintern Abbey and Ragian Castle, the Forest of Dean, Merthyr, Brecon, and to some of the numerous collieries and iron works in the South Wales coal-field A practical natural history excursion is being organized by the Cardiff Naturalists' Society to the Vale of Neath, which from the beauty of the spot should prove attractive Several owners of works in the neighbourhood of Cardiff have expressed their willingness to throw them open to the members, and arrangements will be made for visits to some of them.

(5) Publications —A guide-book to Cardiff is being prepared for distribution to all members and associates, and the descriptive articles have been intrusted to the gentiemen who were best fitted to write inem. The article on the history and whilst that on the topography of Cardiff was undertaken by the late James A. Corbett, who, unfortunately, died before it was quite complete. Mr. T Forster Brown, President of Section G, has undertaken the description of the mining, geological, and statistical features of the district; the industrial portion being in the bands of Mr.

Gallowsy. The geological, soological, and botanical descriptions have been written by Mr. T. H. Thomas and Prof. W. N. Parker, with the help of many others. The account of the educational arrangements of Cardiff will be treated of by Mr. Whitmell, Inspector of Schools, and Principal J. V. Jones

The excursions hand-book will contain a map, on a scale of four miles to the inch, of the whole of the district in which the excursions will be held, specially prepared for the Committee by Messrs. Bartholomew and Co, Edinburgh. As detailed accounts as possible of the various points to be seen in the excursions will be given the guide-book, it is thought that a very complete description of everything connected with this portion of South

Wales will be farmished to the visitors. Other Committees have been formed for the evening lectures and the working men's lecture, but little more can be said shout them than that they will provide to the fullest extent for the wants of the Association. The Local Committee are amount shat this shall be the case in every particular, so that the first visit to the metropy particular, so that the first visit to the metropy meetings of the Association.

R. W. ATRISTON

MARINE BIOLOGICAL ASSOCIATION OF THE UNITED KINGDOM

WE have received the annual report of the Council of this Association, presented at the general meeting on June 24—the President, Frof Ray Lankester, F.R.S., in the chair. In the sea, as well as on land, the severe winter appears to have had a marked effect on the fauna, and there is also a complaint of mortality in the aquarum attached to the Laboratory during the colder months, are result perhaps somewhat unexpected, conndering the comparatively high reference temperature of the sea to the comparative of the properties of the sea of the comparative of the sea of the sea of the sea of the comparative of the sea of the

Under the head of the library (which ought to be represented in the balance-sheet by a larger sum than is at present debited to ii) the Association is to be congratulated on having received the gift of the late Mr Spence Bate's library, constituting an exceedingly valuable collection of the literature of Crustacca.

Some of the changes made in the permanent staff have been chronicled already Mr. Calderwood has replaced Mr. Bourne as Director, and has appointed Mr. H. Dickson to succeed Mr. Gorstang, who took up a Fellowship at the Owens College in December last. Two employing members have been added to the staff. Two employing members have been added to the staff, and the staff of the staff

Eleven gentlemen have visited the Laboratory during the year for the purposes of research, some of them on more than one occasion This number, however, is by no means as large as it should be.

The balance-sheet shows a satisfactory, if small, increase in receipts, the items pointing to an increased use

of the Laboratory, both for research and for the purchase of material for teaching purposes. A sum of £500 (in addition to the annual grant of £500) has been placed on the Civil Service estimates for the current year, which will, if passed, place the Association in a position to carry on its work with less difficulty than has hitherto been the case

UNIVERSITY EXTENSION STUDENTS AT

THE work done by University Extension students at Cambridge last year was so satisfactory that the Syndicate for local lectures are encouraged to repeat the experiment this year. They will be prepared to receive a larger number of students, say from 60 to 80, most of whom will be lodged either at Selwyn College or at Newnham College. The period of study will last from July 28 to August 22, or nearly a month in all byndicate have just issued a detailed programme of the various courses of study, and we are glad to see that due attention has been paid to the claims of science as well as to those of literature and art. At the chemical laboratory, on alternate days, there will be a course of demonstrations illustrating the methods of chemical manipulation in a short series of typical experiments. The pupils will be first shown each experiment, and will then be expected to repeat it for themselves. At the then be expected to repeat it for inemselves. At the Cavendish Laboratory, on alternate days, a course of short experimental lectures, chiefly on electricity and magnetism, will be delivered, and most of the experi-ments shown in the lectures will afterwards be performed by the students for themselves Geology will be studied, on alternate days, at the Woodwardian Museum, where on alternate days, at the woodwaldian muscul, there will be a course of demonstrations on the leading fossil types of the animal kingdom, from the specimens in the Museum A course of demonstrations, followed by practical work, will be given, on alternate days, in the physiological laboratory, and Mr Graham, chief assistant at the Observatory, will receive students and explain the as the Observatory, win receive students and explant the uses of astronomical instruments. Afrangements will also be made for taking small parties of students to the Observatory at night. Single lectures will be delivered by various eminent Cambridge men, and in this part of the work science will be represented by Prof G. H. Darwin, who will lecture on the history of the moon or some allied subject. We may note that the students in science will be allowed to read in the Philosophical Library.

NORMAN R. POGSON, CI.E.

WE regret to have to announce the death of Mir Norman Pogson, for thrity years the Director of the Observatory at Madras Mr Pogson has been so long absent from England that, in a sense, he may be said to have outlived his reputation, but those who can recall the condition of astronomy in this country some thirty years since will remember him as a rising astronomer of considerable promise, and as one of the most indefangable observers at that time. If his subsequent career has not entirely fulfilled his early promise, perhaps the condition of the Madras Observatory is to some ment is very old and inadequate, and possibly Mr Pogson has accomplished all that could be done with his instruments and his staff.

ments and his staff.

Mr Pogson's astronomical career commenced at Mr Bishop's Observatory in Regent's Park, at that time under the direction of Mr J R. Hind, and he there took part in the observations for forming the ecliptic chairs published from that Observatory. In 1851 he left London

to assume an assistantship in the Radcliffe Observatory, Oxford, under the late Mr. Johnson; and there his zeal was rewarded by the discovery of several minor planets, in days when the number of the known asteroids was comparatively small, and their discovery conferred some little distinction upon their fortunate discoverer. Of greater importance to astronomy was his subsequent devotion to variable stars and photometry, the latter carried out, we believe, with the apparently inappropriate instrumental means of the heliometer of the Radcliffe Observatory. Oxford. But the result of his investigation of the amount of light that separates two consecutive magnitudes has never been displaced, and the fortunate employment of the number, whose logarithm is 04, to express this ratio will probably long connect Mr Pogson's name with the history of accurate photometry.

After a somewhat short stay at the Hartwell Observa-Mr Pogson left England in 1861 to take charge of the Madras Observatory. His direction of that institu-tion will always be remembered in connection with the extraordinary discovery of a telescopic comet, effected in consequence of the telegraphic communication he received from Prof Klinkerfues, who expected that Biela's comet might be seen in the constellation Centaur, after the brilliant meteoric shower to which that comet had given rise in November 1872 Mr Pogson looked in the direction indicated, and by a remarkable coincidence found a comet, which he observed on two, and only two, occasions The orbit remains, therefore, indeterminate, but there is good reason to believe that the object seen was in no way connected with either of the two condensations which together make up the lost comet of Biela And thus another and not uninteresting chapter was added to the history of this comet Several volumes of observations have been published under Mr Pogson's direction, the last bears the date of 1870, so that probably, and as the Director has often lamented, the reductions are considerably in arrear

It will be interesting to watch the future of this Observatory It is to be hoped that some steps will be taken to place it more in accordance with the requirements of the present time. We believe that its abandonment has even been canvassed, but it cannot be sufficiently regretted if an Observatory, possessing as that does many historical associations, and occupying a very favourable position on the earth's surface, be allowed to disappear. W. E. P.

NOTES.

THE death of Wilhelm Weber, the illustrious physicist, is announced He died at Gottingen on June 23 On a future occasion we shall give some account of his services to science.

THE second lecture in connection with the Faraday Centenary was delivered by Prof Dewar, F R S, at the Royal Institution on Friday evening last.

On Tuesday, Lord Cranbrook, in the House of Lords, moved the second reading of a Bill the object of which is to allow the managers of science and art schools to transfer them to local authorities when they desire to do so. Lord Cranbrook explained that at present there were considerable difficulties in the way, and that the process was a very long and tedious one. The Bill proposed to make these schools transferable in the same way as ordinary schools could be transferred to School Boards. The Bill was read a second time.

DRS. J. BORNMÜLLER AND P. SINTENIS propose to occupy the present summer with an investigation of the flora of the islands Samothrace and Thasos, from which very few collections are to be found in European herbaria, also of Mount Athos

and of the Bithynian Olympus, They then intend to take up their winter quarters in Mossul, and to spend the following spring and early summer in the comparatively unknown mountainous region of Diebel Hamzin near Bagdad, and the mountains to the north and east of Mossul.

THE distinguished Italian botanist, Prof O. Penzig, is about to start on a botanical expedition to Massowah and Bogos.

MR I T NICOLSON, at present Prof. Ewing's demonstrator in the University of Cambridge, has been appointed to the Chair of Mechanical Engineering in the McGill University. Montreal

A STALL for the sale of "zoological photographs" has just been opened in the Zoological Society's Gardens. It is placed in the centre of the Gardens, near the band-stand, and has an attractive exterior The photographs sold are mostly representations of animals in the Society's Gardens, but also include some taken in the Jardin d'Acclimatation of Paris, and in other similar establishments.

THE marine laboratory of the Johns Hopkins University will be open this summer at Port Antonio on the north-east coast of Jamaica According to Science of June 10. Prof. Brooks and some members of his party had already started for the station.

THERE has been lately formed in Berlin (we learn from Natur w. Rasch) a "Union of frieads of Astronomy and Cosmical Physics," with the view of organizing practical co operation in these subjects of research in Germany, Austria, Hungary, Switzerland, and neighbouring countries, and also in the colonies, and where membership may be desired. The object is to be sought by means of free communications of the members or groups of members to head quarters, whence advice and results of observations, &c , will be i-saed, Sections are formed for observations (1) of the sun , (2) of the moon , (3) of the intensity and colour of starlight and of the Milky Way , (4) of the rodiacal light and meteors , (5) of polar light, terrestrial magnetism, earth currents, and atmospheric electricity, and (6) of clouds, halos, and thunderstorms. Prof Lehman Filhes has been elected President of the Union, and the presidents of the sections are Forster, M W Meyer, Plassmann, Jesse, Weinstein, and Reimann.

ACCORDING to a telegram sent through Reuter's Agency from San Francisco on June 29, a series of sudden sharp earthquake shocks, accompanied by subterranean rumblings, passed through San José, California, that morning The first shock was so violent that the electric-light tower, two hundred and forty feet high, swayed for at least ten feet. A panic prevailed in the town, and in two of the principal hotels, which were filled with tourists from the East, men and women rushed half dressed from their rooms into the corridors in a great state of alarm. The city rocked like a ship in the trough of the sca, and when the second shock occurred, buildings rose and fell with a slow uadulating motion, one partly erected brick building tumbling to the ground Many chimneys fell, and a large number of wiadows were broken, while considerable damage was done to crockery and other fragile articles in the houses

GERMANY had very heavy rains on November 22 to 24 last year, causing floods at a rather unusual time in the region of the Elbe, Weser, &c It is shown by Prof. Hellmann, that Middle and West Germany were then on the front side of a deep depression, which passed very slowly from north to south, taking about 90 hours from the North Sea to Central Germany, less than half the usual speed from west to east. A region of high pressure with cold lay to the east, blocking the course in that direction, and this afterwards spread over the flooded country, covering it with ice.

THE Central Mcteorological Observatory at Tokio, Japan. has begun the publication of hourly meteorological observations. commencing with January 1890 The observations are contained in monthly Bulletins, and include all the usual elements, together with vapour tension, humidity, earth temperature, bright sunshine, and hourly and daily means Meteorological observations have been made for some years in various parts of Japan, including hourly observations at Tokio since January 1, 1886, but have hitherto only been published for certain hours. The observations are all made without selfrecording instruments, excepting those of wind and sunshine Some years ago the Director of the Service, I. Arai, visited this country, and other European countries, for the purpose of studying the various meteorological organizations, and we have no doubt that this important publication will be very valuable for meteorological researches referring to the North Pacific Ocean, where information is comparatively scanty

M. MASPERO has an interesting article in the current number of La Nature on the dog in ancient Egypt It is illustrated by representations of dogs reproduced from Egyptian monuments. and by a mummy of a dog recently opened and sketched by M Beckmann. In ancient Egypt, as in modern Europe, the dog was regarded both as a friend and as a useful servant. He also received the honours of a god, and there are cemeteries of does (corresponding to the cemeteries of cats) where minimies have been found by the thousand Attempts have been made to identify the various species of dogs represented in wall paintings, but those naturalists who have investigated the subject have not always arrived at the same conclusions. M Maspero points out that mummies supply more trustworthy materials for study, and urges that men of science should lose no time in examitting some of them, as cemeteries of animals are being very rapidly "exploited"

A COMMERCIAL company has for some time been working quarters in the neighbourhood of the well knowing jaleaul grooves at Kelley Island, Ohio, and it was feared that these remarkable relies of the glacial epoch might be wholly destroyed Fortunately the president of the company understands the interest of the phenomens, and has taken care to prevent the most artiking of them from being injured. We learn from the Grevanda Leader that some of the grooves have now been readered aste, the company at its recent annual meeting having decided that the crocks on which they are farrowed should be made over to the presented in the presented over the three distributions, and the state of the company of the presented in the presented over the presented in the presented over the three first of the presented in the presented over the presented in the presented over the three first of sections.

MR C DAVIES SHERBORN IS, we are glad to find, making satisfactory progress with the stupendous task he has undertaken in the production of his "Index Generum et Specierum Animalium" Mr Sherborn has found it absolutely necessary to accept the year 1758, the date of the tenth edition of Linneus's "Systema," instead of the twelfth edition (1766), as the startingpoint of binomial nomenclature in zoology, and this decision was greatly strengthened by the advice of Prof Sven Loven. Dr D Sharp, and others who had carefully studied the question. This is the only alteration which has been made in the original scheme (see NATURE, vol xln. p 54) During the year, five hundred volumes have been worked through, page by page, and a total of forty thousand species have been recorded, are duplicate, involving a use of 80,000 slips Each species is recorded on a separate slip (5 inches x 21), the whole of the reference, with the sole exception of the page, being printed with india-rubber type, thus insuring perfect accuracy of date and parts of volumes: as the pages are also checked during work, the chances of misquotation are reduced to a minimum. As the volumes mentioned include the whole of the publications of Linnieus, many of Fabricius, Thunberg, and other voluminous authors of that early period, it is, perhaps, permissible to think that more rapid progress may be made in future years. The dates of publication of the separate parts of a work have been carefully attended to, and much value ble information has been obtained. Some of this has appeared in the Annals of Natural History (Pallas's "Icones Insect ." "Nov Spec Quad.," and While's " [ournal"], while much remains in manuscript until the final completion of detail admits of its publication. As is well known, the authorities of the Natural History Museum have rendered every facility to Mr. Sherborn for the prosecution of his work, and the storage of the manuscripts within the walls of that institution, reducing the risk of loss by fire to a minimum, is a concession highly valued by the author. One set of the slips is arranged in order of genera, and, on application, is available for reference to anyone compiling a monograph of a genus The manuscript is frequently consulted by those working at the Natural History Museum, even in its present imperfect state, and will, from the very nature of the method of recording, prove of increasing value as it grows to larger proportions

In the report of the trautees of the South African Museum for Bogo it is stated that the curstor, Mr. R. Trimen, has completed a thorough rearrangement of the fine collection of South African Durrial Lepdopters in accordance with the monograph of those meets recently published by him, incorporating many additional species, and replacing imperfect or wore examples by freiller and more characteristic specimens. He has also begun the rearrangement of the more numerous and less known Crepta cular and Nocturnal Lepdoptera. Mr. Trimen has completed for publication two papers—one on the very interesting series for publication two papers.—one on the very interesting series were considered to the series of the serie

An interesting account of the nest and eggs of the cat bird (.leluradus verides, Latham) is given by Mr A J North in the latest number of the Records of the Australian Museum (vol 1. No 6) The habitat of the cat bird is the dense scrubs of the constal ranges of New South Wales Although the bird is common, authentic specimens of its nest and eggs seem to have been unknown until lately For an opportunity of examining such specimens, Mr. North is indebted to Mr W. J Grimes, an enthusiastic cologist, who recently secured two nests of this species on the Tweed River The nest is a beautiful structure, being bowl shaped, and composed exteriorly of long twigs, entwined around the large broad leaves of Ptarietia argyrodendron, and other broad leaved trees, some of the leaves measuring eleven inches in length by four inches in breadth. The leaves appear to have been picked when green, so beautifully do they fit the rounded form of the nest, one side of which is almost hidden by them The interior of the nest is lined entirely with fine twies. The eggs are two in number for a sitting, oval in form, being but slightly compressed at the smaller end, of a uniform creamy white very faintly tinged with green, the shell being comparatively smooth and slightly glossy. Although the cat bird is usually included in the family of bower-building birds, Mr North has never known or heard of its constructing a hower

A CATALOGUE of the Australian birds in the Australian Museum, at Sydney, by Dr. E. P. Ramsay, is being published. Part III., which has just been issued, deals with Paittaci.

As a substance peculiarly fitted, by reason of its high dispersive power, and transparency for ultra-violet rays, for study of theultra-violet part of the spectrum, Herr Wolter has recently recommended, in a Hamburg serial, a-monobiomanchtalin With a prism of the liquid, he could trace the spectrum beyond N on a fluorescein-solution. Besides the above named properties, the substance has for boiling-point 277° C; it has an offensive smell like carbon sulphide, and its index of refraction varies much less with temperature than in the case of that bound

THE material resources of the southern part of Maryland are sill so ungerficitly known that a scennific expedition for the investigation of the district was recently organized. The expedition was formed under the joint asspaces of the Johns Hopkins University, the Maryland Agricultural College, and he U.S. Geological Survey. An interesting report of the work done has been published in one of the Johns Hopkins University Circulars.

DA ALPRED TUCKERMAN has compiled an excellent "Bibliography of the Chemosal Inflaence of Light," which has been published as one of the Smithsonian miscellaneous collections. As the compiler had in verw only the scientific aspects of the subject, he has omitted nearly all the practical applications, including that of photography. An index to the intensive of photography is being prepared under the majnees of the common of the Alvancement of Science.

Tits College of Scence, Imperial University, Japan, has susued the first part of the fourth volume of its Journal. It opens with a paper on the fetal membranes of Chelonia, by K. Mitsakuri After this come the following articles—On the development of Aranena, by Kamakichi Kahinonye, observations on frish-water Polyzon, by A. Oka, on Different sufferium, n. sp., by Seitaro Goto, a new species of Hymenomycetone Fungus injurious to the mulberty tree, by Nobajiro Tanaka; notes on the irritability of the saigma, by M. Myroshi, notes on the development of the suppraesal boddes in the mouse, by Masaniro Inaka. Each of the papers at allustrated.

MR. C. C. VRVERS, Leeds, has sent us a copy of the fourth edition, illustrated, of his "Practical Amateur Photography" The volume is described in the preface as "a simple text book for the beginner, and a handy work of reference for the advanced photographer " Mr Vevers has also published an illustrated catalogue of photographic appraisus.

THE Manchester Microscopical Society has issued its Transactions and Annual Report, 1890 The volume includes two Presidential addresses by Prof Milnes Marshall, papers and communications read by the members, and a last of members

We have received from Mr William F Clay, Edinburgh, a catalogue of scientific books which he offers for sale. The works relate to chemistry and allied sciences

As briefly announced in our report of the last meeting of the Paris Academy of Sciences a new compound of iron and carbon monoxide has been obtained by M. Berthelot, analogous to the nickel compound described last year by Messra Mond. Lang. and Quincke In order to obtain it, the iron requires to be in a very finely divided state, and free from admixed oxide. It is most suitably obtained by reducing dried precipitated ferric oxide or oxide obtained by ignition of ferrous oxalate in a current of pure hydrogen. When carbon moaoxide is led over metallic iron thus prepared, and the tube containing it gently warmed to about 45° C., the reaction commences, and if the issuing gas, after being washed through water, is ignited at a jet, the flame is observed to be quite different from that of pure carbon monoxide, being brilliantly luminous, almost white, and emitting rays which furnish a definite spectrum. Moreover, if a cold porcelain tile or evaporating basin is depressed upon the flame a deposit of metallic iron more or less admixed with oxide is obtained.

indicating the existence in the issuing gas of the vapour of a ferruginous compound. A drop of dilute hydrochloric acid at once dissolves the stain, and the solution affords the ordinary reactions of 1ron, yielding Prussian blue with potassium ferrocyanide for instance. When the gases are passed through a strictured tube, such as is employed in Marsh's arsenic apparatusa portion of which is heated to redness, an annular deposit of metallic iron is obtained, containing a slight amount of admixed carbon. M Berthelot has not yet succeeded in obtaining sufficient of the new compound to condense it to the liquid form, but further experiments with that end in view are in progress. The formation of this volatile compound of iron and carbon monoxide will undoubtedly prove of great interest from a metallurgical point of view, as it may assist in elucidating several of the as yet little understood furnace reactions. M. Berthelot further expresses the opinion that it may help to explain the formation of bubble flaws in manufactured from which have so frequently led to such unfortunate re-ults. In addition to the preparation of Iron carbonyl, M. Berthelot describes several new reactions of nickel carbonyl. It will be remembered that this substance is a liquid boiling at 46°, so volatile that, according to M. Berthelot, its vapour tension at 16° is a quarter of an atmosphere A drop placed upon a glass plate rapidly volatilizes, the portion last to disappear being for a few moments cooled down by the evaporation of the first portion to such an extent as to form beautiful little crystals When suddenly heated to 70° it detonates, the detonating reaction being expressed by the countion Ni(CO), = 2CO, + 2C + Ni When mixed with oxygen, simple agitation of the tube containing it over increury brings about detonation. When oxygen is permitted to slowly gain access to the liquid oxide, a solid substance is formed, which is green if the oxygen is moist and brownish-yellow if dry. In contact with oil of vitriol the liquid compound appears to be unaffected for a few moments, but suddenly explodes with production of flame Nitric oxide reacts in a most beautiful manner. either when passed into the liquid or its vapour, bright blue fumes being produced of a complex compound, which eventually anbside, forming a blue solid These blue vapours completely fill the whole vessel, and their formation affords one of the prettiest experiments yet described

CONTEMPORANKOUSLY with the above work of M. Berthelot, Mr. Mond and his co-workers have also been conducting experiments with the view to the preparation of iron carbonyl, which have been so successful that a brief account of them was laid before the Chemical Society at their last meeting. Further particulars of these experiments will be given as soon as published.

THE additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (Macacus rhesus 9) from India, presented by Mr Albert Job, an American Red Fox (Canis fulvus) from North America, presented by Mr W. Reading, a Two-spotted Paradoxure (Nandinia binotata) from West Africa, presented by Mr E. G. Parkinson, a Sinaitle Ibex (Capra sinastic) from Palestine, presented by Sir James Anderson , two Gaimard's Rat-Kangaroos (Hypsiprymnus gaimards) from Australia, presented by Mr. Walter Howker, a Cuckoo (Cuculus canorus), British, presented by Mr. Stacy Marks, R A., F Z S , two Red-billed Tree Ducks (Dendrocygna autumnalis) from America, presented by Mr. Keswick; two White-faced Tree Ducks (Dendrocvena viduata) from Brazil. presented by Captain C A. Findlay, R.N R.; a Common Viper (Vipera berus), British, presented by Mr. J. Sargeant; two White-headed Sea-Eagles (Haliactus leucocephalus) from North America, deposited, a Burchell's Zebra (Equus burchelli &), a Derbian Wallaby (Halmaturus der bianus), three Common Night Herons (Nucticorax priseus), bred in the Gardens.

OUR ASTRONOMICAL COLUMN

THE CAPILIER THEORY OF COMETS.-The last three numbers of the Bulletin Attronomique (April-June) have contained papers by M. L. Schulliof, "Sur les Grandes Perturbations des Comètes by M. L. Schulloi, "Sur les Grandes Perturbations des Comètes Périodiques," which place beyond doubt the idea that the periodic comets of our system are captured by the perturbing action of planets. The main object of the research was to develop the relations existing between the elements of the comet's orbut the relations existing between the elements of the council young before and after its entrance within the sphere of activity of the disturbing planet. With the criteria obtained, and some results previously formulated by M Tisserand, it is possible to decide the question as to the identity of two comets of which the time of revolution of one is known, even when the comet is believed to have passed several times within Jupiter's sphere of activity between two apparitions. This result is of the highest importance, for it is only by such means that individual comets can be identified. They cannot be recognized by their appear-

ance, as they possess no peculiar characteristic that can be telescopically observed.

M. Schulhof suggests that, in the light of recent work, periodic comets should not now be classified according to their aphelior contents around not now de classifier according to their appears of detacles, but arranged in groups the mean appletion distinct of or other of the planets. Such a division has been made for comest having periods between 10 and 10,000 years. From the tabulated results, it appears that four camets have appletion distinction with the property of the planets. tances which differ but little from the application distance of Mercury. The Venus group numbers seven, the earth's group ten Mars possesses four comets, and Jupiter twenty-three Saturn has a family of nine, Uranus eight, and Neptune five

WOLF'S PERIODIC COMET (b 1891).—The following ephemeria is from one given by Frof Berberich in Edinburgh Cricular No. 17. From Astronomich Machrichten, No. 3942, it appears that Dr. Spitalier observed the comet on May 2, that is, before Frof Earnatd I he brightness on the date (May 4) of rediscovery by the latter observer has been taken as unity

					ヒル	en	ıer	es f	r Bei	lin Midni	ght		
189	z8gz. RA			Decl			I og a	Log r		Bright			
		- 6	Ļ	m				۰					
July	6		1	4	34		+	26	30 3	0 1916		5	3 08
**	10		1	15	8			27	15	o 1800	0 227	ċ,	3 30
,,	14		1	25	49			27	28 3	o 1683	0 223	7	3 54
,,	18		1	36	35			27	50 5	. 0 1565	0 220	δ	3 54
,,	22		1	47	24			28	76	0 1440	0 217	8	4 06
	26		ı	58	15			28	193	0 1326	0'215	2	4 34
	30		2	9	7			28	25 2	0 1 204	0.313	1	4 64
Aug	3	••	2	19	57			28	25 1	0 1081	0 210		4 96
,,	7		2	30	42			28	156	0 0957	0 208	ś	5 31
,,	11		2	41	21			28	5 2	0 0832	0'206	3	5 67
,,	15		2	51	51			27	44 7	0 0707	0 205	1	6 05
**	19		3	2				27	166	0 0581	0 204	í	6 44
"	23		3	12	14			26	40'9	0 0455	0 203	2	689
"	27		3	22	Ó			25	57'3	. 0 0329	0 202	,	6 8 9 7 2 8
. "	31			31				25	56	0 0204	0 202		7 72
Sept	. 4		3	40	28			24	5.6	0.0080	0 202		8 18
,,	8		3	49	1		+		57 1	9 9957	0 202	٠.	8 64

The comet is now in Pisce, and in the beginning of September will pass through the Plendes. M. Bigourdan, of Paris Observatory, observed it on June 12, and remarked that it was "une nébulosité ronde, d'eaviron 20" de diamètre, de grandeur 13 3"

YORUBA AND GAZALAND.

A T the meeting of the Royal Geographical Society, on Monday, two papers were read, one by Mr. Alvan Milson, on the Yoruba country, West Africa, and the other by Mr. Denis Doyle, on a journey in Gazaland, in South-East Africa.

The ancient kingdom of Yoruba may be taken as one of the most interesting of the great tribal divisions of West Africa, between the Gold Coast and the Niger.

perween the Gota Cossa and the Niger.

Landing at Lagos, the only natural harbour on a thousand
miles of coast, a narrow entrance with a 55-feet bar leads into
the intricace chain of waterways which extends, with few and
signit mierruptions, for 500 miles from the Volka river to the
Benin branch of the Niger Delta. From the cast and west,

from the Benin river and the waters of the Dahomian frontier, the coast of the gulf is backed by intersecting channels of fresh water flowing steadily from either hand towards the Lagos outlet. In many places these narrow and brinming channels are separated from the onslaught of the Atlantic rollers by no more than hwe or six level yards of shifting sand, the spr from the ocean drifts over them, and the roar of the surf heard by the native as he glides over their calm surface in his fragile canoe. These so-called "largons of the Bight of Benin" form but a small portion of the littoral river systems of West Africa; for from Cape Palmas to Cape Three Points the long Kroo coast is lined by inland waters for the greater part of 300 miles, and beyond the rocky spurs of the beautiful Gold Coast the Dahomian shores have the same remarkable formation. At right angles to this network of channels numerous rivers flow down from the uplands of the interior, carrying in their rapid Streams vast quantities of sand and mud with which they busily build out the land At first sight it seems strange that so many and such powerful streams, flowing strongly towards the sea should suddenly be turned aside from their courses by so narrow and fragile a barrier of shifting sand Io the influence of the sheltering headlands which jut out towards the south; to the rapid Guinea current which tears away the face of their rocky shores and hurries towards the east a ceaseless stream of sand . to the simust ideless ocean, and the absence of high winds, for the strength and duration of a West African tornado are but slight as compared with the hurricanes of the West Indies or the gales of our stormy coast, and above all to the enormous growths of floating papyrus and water grass which line the breaking through into the ocean, are due the formation and con-tinual development of this strange delta system. For these rivers are in most instances choked for many inties by a floating rivers are in most instances chosen for many miles by a floating papyray-sod bound together by wild water-fig: and palm-wine palms (Azphia vini/rza), and when the floods come down from the interior great masses of this floating vegetation are torn away and carried down to the lagoons and onwards towards the sea Hundreds of acres of these grass islets are annually carried down from each of these rivers, and are driven against the banks of the lutoral lagoons, where they lodge and grow, and eventually become anchored in their places by more permanent vegetation.

In this manner the lagoon sides are padded for hundreds of in this manner the ingoon sites are pauded for nundreds of yards, and even, in some instance, for two or three miles in depth on either hand, and their banks are protected from the wash of the current and the weight of the accumulated waters, By this means the final barrier of sca-sand is strengthened, and By this means the trail parrier of sea-sana is acceptioned, and the inland waters, although they frequently rise to a height of 5 to 6 feet above the sea-level, are effectually prevented from bursting through their banks. Not only are these growths a permanent protection to the land, but by their very nature, floating as they do on the surface of the water, they rise and fall with the floods, and are always ready with their assistance at the right time and place. Were all the rivers which feed the lagoons freed from their natural obstructions, as is the case with lagoons freed from their natural obstructions, as is the case what the Ogun twer near Lagos, the interior to a distance of from thirty to seventy miles would be thrown open to commerce, and the wonderful system of inland navigation which fosters the coast traffic would be still further developed.

Mr. Millson went on to describe a journey from the coast to

MI. Milliod went on to describe a journey note to construct the literor, the country raing from terrace to terrace. He then spoke at some length of the Yoruba people and country. About eighty miles from the coast, at Oda Ona Kekere, the dense forest suddenly gives place to open cultivated land, and a densely peopled country. Some three miles to the north of Odo Ona Kekere, from the crest of a to the north of Odo Ona Keerer, from the crest of a rising in the undulating land the great city of Ibadan— the London of Negroland—comes full in view, extending for over aix miles from east to west, and for more than three from north to south. Surrounded by its farming villages, 163 in number, Ibadan counts over 200,000 soul-, while within the walls of the city itself at least 120,000 people are gathered. Its sea of brown roofs covers an area of nearly 16 square miles, and the ditches and walls of hartened clay which surround it are more than 18 miles in circumference. Its houses are built round more than 18 miles in circumstenence. Its houses are built round courtyards with a single circumser, and form in themselves no courtyards with a single circumser, and form in themselves no courty and the single circumsers and the single circumsers are made of a light covering of palm leaves and grass in order to avoid the danger of extensive configurations. In the winding tocky attents which interacts these large compounds in every

direction, are countless market booths and occasional market direction, are countless market booths and occasional market places, where the inhabitants can purchase native produce, food, and European luxuries. In the same way, by the sides of the country roads, are built at tregular intervals varying from one to six miles, long low sheds close by some well or running water, where the farm women sit and "make their market." In the farms the farm women sit and "make their market". In the farms which extend throughout the country from horison to horison as one journeys through it, save where the land is too poor, or the fear of war has desolated the neighbourhood, can be heard the crowing of cocks, the barking of dogs, the shrill laughter of children, and the vociferous clamour of native homestcad gossip. For among natives, as among seafaring folk at home, a hundred yards or so is no impediment to polite conversation. From this being naturally pitched for distant communication cannot readily be restrained or focussed for nearer ranges of social intercourse. The consequent turmoil and shrill cries are apt at first to un settle the nerves of an inexperienced traveller, but a few weeks' residence in the country not only accustoms one to their manner of speech, but inures one's system to the sudden shock of their rous voices.

Northward from Ibadan, which may be described as the Northward from Itadaa, which may be described as the centre of the chief military and commercial power in Yoruba, centre of the chief military and commercial power in Yoruba, centre of the chief with the control of t spur which leaves its traces in deep scores along the flanks of the poor animals. Far and wide the land has for generations, and indeed for centures, been cultivated by these industrious natives. The hatchet, the fire and the hoe, have removed all traces of the original forest, save indeed where a dark trail of green across the landscape shows where the valley of some narrow watercourse or larger river is hidden among trees. For two or three years at most the land is allowed to be fallow, while for three or four years double or treble crops are raised with no further cultivation than an occasional scrape with a hoe, and during its fallow time no further care is taken of it than to let a during its fallow time no further care is taken of it than to let a rank growth of reedy grass spring up some 6 or 5 feet in a rank growth of reedy grass spring up to the control of the restriction of th generations to support its owners

Mr. Doyle, who accompanies King Gungunhana's two envoys to this country, described his journey from the Mashonaland plateau down through Gazaland to the mouth of the Limpopo At first the journey was through a broken platean country, issing to 5000 feet and over, and well adapted for farming ising to 5000 feet and over, and well adapted for larming operations. After fources days' travel, the country suddenly form and the fources of the country suddenly for many miles the altitude was no more than 300 feet, and as it was the rainy season when Mr. Doyle and his companions passed through, they found the country almost entirely a swamp. The actual distance travelled was between 700 and 800 miles, which was traversed in forty-six days

THE CONDITION OF SPACE

THE question of the condition of inter-planetary space, with special reference to the possibility that it offers a resistance to the passage of the heavenly bodies, has for long occupied the attention of astronomers, but is even yet far from receiving a satisfactory or definite solution. Three hypotheses seem to be

a satisfactory or dennite soution. I arrie nypotnesse seem to ue more or less in vogne.—

(i) That it is filled with "ether," differing entirely in its properties from ordinary matter, and offering no resistance to the passage of solid or gaseous bodies. Radiant energy as transmitted by the vibiatory motion of the ether, and pos also the force of gravitation is transmitted by a rotatory motion, though, as Laplace points out, the velocity of the gravitation mu t be at least 7,000,000 times that of light

(2) That it is filled with an ether more analogous to ordinary satter, which offers resistance, or with a highly rarefied gaseous

matter, which ouers resistance, or with a nightly matter gaseous medium similar in constitution to our atmosphere.

(3) That it is filled with ether, through which innumerable solid bodies of comparatively small size fly singly or in swarms. When they encounter one another, a gas, or a planet, they become laminous, and present the appearance of fireballs, become laminous, and present the appearance of fireballs, meteorites; shooting airs, neteoricy comets, neterice warms, meteoried dust gives rule to the phenomenon of the aurous boreals. The theory has recently been much extended and boreals, the theory has recently been much extended and the control of th

continue indefinitely

If the second hypothesis be true, the resistance, however slight it may be, will tend to retard the motion of the planets. In the case of the earth the friction between the outer layers of the atmosphere and the medium will retard the rotation of the earth, and increase the length of the day. There will also be a to decrease the velocity, and therefore to lengthen the year; but, on the other hand, if the tangential velocity he decreased while the attraction of the sun remains the same, the earth will fall towards the sun, the mean distance will decrease, and therefore the time of revolution will be shortened

If the third hypothesis be true, the rain of meteorites will have no effect on the rotation of the earth, but will tend to

lessen the orbital velocity

lesses the orbital velocity. Lapinee has disquised some consequences of the second hypo there in "Mécanique Céleste," vii 6, on secular variations in the novement of the moon and cards which might be produced by the resistance of an etheral medium spread round the sun distance from the sun, and that the resistance verse as the square of the velocity. He concludes that the acceleration produced by the resistance of a fluid either on the mean motion of the moon is, up to "the present time," in sersible, and that the acceleration produced by the same either on the motion of the earth would he loss than 1/100 of the earth would he loss than 1/100 of the relative to the control of the relative to t tended to other planets and to comets in x. 7, where it is shown that the distance at penhelion remains unchanged, and the only alteration in the orbit is a decrease in the length of the major

attention in the orbit is a sections: In the control was a sand in the eccentricity.

The question is discussed from a mathematical point of view in several text-books (e.g. Tait and Steels, "Dynamics of a Particle," pp 279, 379), but in all cases the mathematics are somewhat difficult, and various assumptions have to be made to render the solution possible

In the case of the earth, if the resistance of the medium be small, the orbit may be considered to be circular, more espe-cially as it follows from Laplace's results that the error introduced decreases with the time, since the orbit becomes more nearly circular. The following brief abstract of the popular treatment suggested by G A Hirrs in his "Constitution of Pisapec Celeste," pp 104-108, with the substitution of English values, and the extension of the results to the meteoric hypo-

thesis, may be not without interest at the present time.

Many of the data are so uncertain, that the rough approximations by which mathematical difficulties are avoided probably produce no great loss of anthmetical accuracy in the results

produce no great loss of arithmetical accuracy in the results. The ver wrave of the earth at the end of any period is equal to the ver wave at the commencement of the period, less the ver wave lost owing to the revistance of the medium, and increased by the ver viva due to the fall towards the sun Transposing. and dividing by M/2-

$$v_r^2 = v_t^2 + v_t^2 - v_t^2$$
.

Writing S for the attraction of the sun, and resolving along the radius vector A-

$$v_o^2/\Lambda_o = S$$
, $v_o^2 = S\Lambda_o$
After a time t .

$$v_t^3/A = S \frac{A_s^3}{A_s^3}, \quad v_t^3 = SA_s^3/A_t$$

The acceleration towards the sun is expressed by

$$\frac{d^2A}{dt^2} + S \frac{A_c^2}{AC} = 0;$$

and integrating.

$$v_{I}^{1} = 2 \text{SA.} \begin{pmatrix} A_{\sigma} - 1 \\ A_{f} - 1 \end{pmatrix}$$

Substituting and reducing,
 $v_{I}^{2} = v_{\sigma} \begin{pmatrix} A_{\sigma} - 1 \\ A_{f} - 1 \end{pmatrix}$.

Hence the ves viva lost, owing to the resistance of the medium, is one-half of the vis viva gained by falling through (A. - A.) towards the sun, and the presence of a very slightly $(\Lambda_0 - \Lambda_0)$ towards the sun, and the presence of a very signtly resisting medium surraces the velocity of the earth in its orbit. This increase is easily expressed, since, by Kepler's third law, we may replace $(\Lambda_0/\Lambda_0)^3$ by $(T/T_0)^3$, where T_*T_0 are the periodic times at the beginning and end of the period,

$$\therefore \ v_{r}^{2} \approx v_{r}^{2} \left\{ \begin{pmatrix} T_{r} \\ T_{r} \end{pmatrix}^{\frac{1}{4}} - 1 \right\}.$$

But the vis zero lost owing to the resistance is equal to the work done in forcing the sphere against the resistance of the medium through the distance passed over by the earth during the time. We may assume for simplicity that during the last 2000 year the length of the year has shortened by five second; and since the change in the radius vector would be very small, that A = 233000, where a is the radius of the earth, and hence that the distance through which the earth has passed is

2r 233002 2000
M. Hirn, by theory and experiment, shows considerable reason for believing that the formula of Hutton, for the resistance of a medium in terms of the density δ , gives a result not far from the truth. Hence

$$\begin{array}{ll} \text{O.451} & \sim (\pi a^5)^{1.1} \times \delta \times v_{\nu}^{-1} \times 2\pi \, 23\, 30\, oa\, 2000 = \frac{M v_{\nu}^{-1}}{2} \left(\frac{T_{\nu}^{-1}}{T_{\nu}^{-1}} - 1\right), \\ \text{where} & \left(\frac{T_{\nu}}{I_{\ell}}\right)^{\frac{1}{2}} - 1 = \left(1 + \frac{5}{31558150}\right)^{\frac{3}{2}} - 1 = \frac{1}{9467445} \\ & \frac{1}{8} = (\log^{-1}14\, 32\, 278) \times 4\pi^{-\frac{3}{2}}/\Delta, \end{array}$$

where A is the absolute mass of unit volume of the material of the earth

. .
$$\frac{1}{8} = 5.64 \times 10^{14}$$
 cubic feet.

M Hirn further points out that this decrease of five seconds in the length of the year during a period of 2000 years would be accompanied by a change in the longitude of the earth of more than 205", an amount quite inadmissible since the time of Hipparchus, while the above results have shown that, to pro-duce an acceleration so small as this, the medium must have a duce an acceleration so small as this, the medium must have a ranty such that one pound occupies 564 billions of cubic feet And the volume occupied by a pound of the gas very nearly varies inversely as the number of seconds gained in the periodic When we pass on to consider the retardation caused by the

action of meteorites, we lose the guidance of M. Hirn, but are able to refer for data to Prof Lockyer's treatise About 30 miles, or 158,400 feet per second, may be taken as the average velocity of meteorites (p. 68) Suppose the earth at rest, and struck by a meteorite weighing one pound with this velo-

city, the vis viva of the blow would be $\frac{1}{2}$ (158400)2=3.98 × 108

absolute foot-pounds (p. 64).

But the earth is moving in its orbit with a velocity of 18 4 But the earth is moving in its oront with a velocity of 18-d miles, or 97, 30 feet per second, hence, of every three meteor-ities we may presume that two strike the front, and one the back bemisphere. Further, the velocity of the earth is, in the one case, to be added to, and, in the other case, subtracted from, the

Suppose that a meteorite weighing one pound has the specific heat 0.2, which is about double of that of iron, to raise it from - 270° C. to 2000° C., 454 units of heat are required, which are equivalent to about 454 \times 44758 = 2 \times 10² absolute foot pounds of work—a quantity which may be neglected, in comparison with the total vis river of the meteorite.

the total vis viva of the meteorite.

The weight of meteorites var.es from tons to small specimens (p. 19), and hence we must assume an average weight of pounds. According to Newcomb, 20,00,000 meteorites a day enter our atmosphere (p. 69). We may again assume that the action has continued for 2000 years, and caused a shortching in

the periodic time of five seconds

The vis viva of the impacts,

$$\mu < 4.58 \times 10^9 \times \frac{20000000}{3} \times 365 \times 2000$$

must be equal to the rus prous lost by the earth,

$$\frac{1}{3}Mv^2$$
 $\left\{ \begin{pmatrix} I_0 \\ I_1 \end{pmatrix} = 1 \right\}$, which is $\frac{4\pi a^4}{6} < 10.86 < (97130)^2$, $6 > 9467445$

$$\mu = \frac{1.95 \times 10^{11}}{1.115 \times 10^{19} \times 2000 \times 9407445}$$
= 9240 pounds, or over 4 tons

In this case, also, the average mass of the meteorites varies inversely as the shortening of the periodic time. Thus, if the average weight of ineteorites is 9 pounds, the shortening would be only o oo5 second-an amount probably mappreciable SYDNEY IUPION

THE FLOWERS OF THE PYRENELS AND THEIR FERTILIZATION BY INSECTS

THE observations described in this work were made in the Vallee de Luz (Ilautes Pyrénces, France), in August 1889 Vallee de Lus (liautes Pyrenes, France), in August 1899, and June 1890, between 1900 and 2200 metres altitude. The notation of a fathern flowers. In the last of the visits, date and altitude are always noted, and in many cases particulars are given about the special habits of insects in visiting flowers. Many of the mentioned insects were not before seen visiting. flowers

The contrivances by which the flowers are fertilized are de-The contributes by which the howers are tentiled and de-scribed for the following species: Merendela Bulbocadium, Asphadelus albus (lepidopterophilous, proterogynous), Hyacin-thus amethysismus (proterandrous, adapted to long-tongued bees), It prenates, Antireheum tempervirens, Linaria origanistila (adapted to bees, with special entrance for Lepidoptera or joha (dapted to bees, with special cutrance for Lepidoptein or Bombylide). Livaria spranica, furnissis spranica, fusionissis spranica spranica, divinissis spranica spranica with special estimates for Lepidoptein, Taurium Pyrinineam with special estimates for Lepidoptein, Taurium Pyrinineam monipatulanus (lepidopterophilosu), Alines sp. Alines estima, Anostima spranicam (recombise the A spranica), Alines and Anabem, Aguilega spranica, Picasia mendana (lepidopterophilosu), Alines primate, Araba fauta, Caramane untream (protectual primate), Araba fauta, Caramane untream (protectual continual primate), Araba fauta, Caramane untream (protectual primate), Araba fauta, fauta fauta (primate), Araba fauta (prima

Association of the contraction of the flower in the following species. Custom creshwar, Contraction of the flower in the following species. Custom creshwar, Carbon Media, Carbon Managar, Carbon media, Carbon Managar, Carbon Sangar, Carbon Managar, Carbon Sangar, Carbon Managar, Carbon of meets in the Alps.

¹ De Pyrenecenbloemen in hare bevruching door invecter 2.6 juges, with five pitter, a Franch resume, and the explanation of the pitter in French in Botonick Janvices, in, 1891, published by the Botanical Society Dodonea, in Chem. Belgium)

On the other hand, Muller noticed that in the Alpa the relative number of Lepidoptera socreases, of hemitrope Hymenoptera (short-tongued bees) decreases in the higher parts of the mountains. The influence of altitude upon those two groups of insects is not evident in the Pyrenees.

is not evident in the Pyreness.

The Lepidopters—which in the Alps, according to Muller, are very numerous—are much less numerous in the Pyreness All the allotrope insects (Colooptera, allotrope Diptera, and allotrope Hymenoptera) are relatively more numerous in the Pyreness than in the Alps. The hemitrope Hymenopters (short-tongued than in the Alps. bees) are somewhat more numerous in the Pyrences than in the Alps, the hemitrope Dipters (Syrphide, Conopide, and Bombylide) are almost equally represented in both the mountains. The ettrope Hymenoptera (long-tongued bees) seem to be equally numerous in the Pyrenees and in the Alps, in both countries, the hymble-bees are predominant, and the not social long-

tongued bees are scarce The following table will enable students to compare the flora

of the ryrenees with that o	tue Aq	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			
	Pvr	enres	Alos		
	Species	Per cent	Species, P	er cent	
Pollen flowers (class Po)	12	(4.6)	14	(3.3)	
Fl with free-exposed honey					
(class A)	34	(130)	42	(10.1)	
FI with parttally concealed					
honey (AB)	45	(17 2)	61	(14.6)	
Fl with quite concealed					
honey (B)	37	(141)	66	(15.3)	
Associated flowers with quite					
concealed honey (B')	48	(184)	84	(20'2)	
Flowers adapted to been					
(Bb)	73	(27 9)	110	(26 4)	
Flowers adapted to Lepi-	. ′3	(-1)/		(4/	
doptera (Vb)	12	(46)	39	(93)	
dopiesa (- 5)				() 3/	
The allotrone flowers	Po. A	AR) are	relatively	more	

numerous, the lenidopterophilous flowers (Vb) are less numerous in the Pyrenees than in the Alps, we have seen that the same differences exist for the corresponding groups of insects

The hemitrope flowers (B, B') are a little more numerous in

the Alps than in the Pyrenees, the contrary occurs with the hemitrope insects There is here accordingly no concordance in the geographical distribution between flowers and insects, but the henitrope insects are not so constant in the choice of their flowers as the allotrope insects and the Lepidoptera; their influence upon the distribution of the corresponding flowers is therefore not so great as that of the two latter groups. The class Bb and the long tongued bees are nearly equally represented in both the mountains. The parallelism which occurs between the relative abundance of the classes Po, A, AB, Bb, and Vb, and the relative abundance of corresponding insects, agrees very nicely with the theory of flowers

It may be observed that in the Pyrenees, with reference to

It may be observed that in the tyrenees, while interests to the hological floral organization, the Chorptetake are, on the whole, on a lower level than the Sympetake Only a small number of Monocotyledonese could be observed.

University Ghent.

J MACLEOD

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Constant of the Senate have appeared W. E. Hill, of S. Johnson (1997) and the Senate have appeared Wood-bridge School, under the new scheme.

The Hardness Scholarship in Geology and Paicontology has been awarded to Herbert Kynaston, of King's College Loses Waller Sudemburgh in Pathology, wasted by the election of Mr. J. G. Adami to a Fellowinp at Jesus College. Mr. Annhack is at prejent in Indoa as a member of the Leptony Control of the Property Control of the Property Control of the Property Indoa as a member of the Leptony Control of the Property Control of t Commission.

The managers of the John Lucas Walker Fund have made a grant of £60 to Mr. E. H Hankin, Fellow of St. John's, for the purchase of bacterlological apparatas required for his

I. H Burkill, of Casus College, has been appointed Assistant Curator of the Herbarium.

Prof. Ewing advertises for a demonstrator in mechanism, wi has had a workshop training in mechanical engineering. salary is £150 a year.

NO. 1131, VOL. 44

The annual report of the Local Lectures Syndicate, published The annual report of the Local Lectures Syndicate, published in the Unsersity Reporter of June 32, records a large amount of useful work in so-called University extension. The number of course given in 189-01 was 153, with an average attendance course given in 189-01 was 153, with an average attendance to the course given in 189-01 was 189-01 with 189-01 was 18

the work of the Syndicate, and it seems not improbable that if a grant of this nature is made permanent a considerable demand will be made upon their staff of lecturers. In Devonshire they have provided at the request of the County Council a Lecturer on Chemistry and a Lecturer on Mechanics, in each case with special reference to applications to agriculture. The lectures in chemistry were given at six centres, those in mechanics at five. The average weekly attendance was—at lectures about 40, at classes about 25, at each centre In all, 64 students presented themselves for examination, of whom 44 passed, 14 obtaining distinction. The audience comprised a number of hoys from elementary and secondary schools, and some working men and farmers and schoolmasters, in addition to the usual mixed audience The lectures were of necessity arranged rather hurriedly, without sufficient time for the local authorities to complete their organization, and they can only be regarded as an experiment. The Syndicate have reason to think that the experiment has been as successful as under the circumstances

could be expected could be expected.
"Having regard to the probability of a considerable demand for lecturers in connection with the County Councils, the Syndicate have added to their list several new lecturers whose attainments mark them out as suitable for this work. And in attaments mark them out as suitable for this work. And in order that the lecturers may have practical acquainance with the applications of their science to the uses of agriculture, the Syndicate have arranged that they should pay vaits to farms of various characters and to the experimental farm at Woburn Mr. H. Robinson, of Downing College, the assistant to the Professor of Chemistry. Mr. Robinson conducts also a course of laboratory work with the lecturers, with special reference to agricultural investigations. The Syndicate desire to express their grateful sense of the help which Prof. Liveng and Mr. Robinson have so liberally given The provision of teaching Robinson have so liberally given The provision of teaching connected with agriculture appears to the Syndicate to be so important for the training of students who may become lecturers on their staff, that they will endeavour to secure a continuance of this assistance, and are prepared to devote a portion of their

of this abstance, and are prepared to devote a portion of midds to the purpose.

The Ords Sensoridate for the year shows that 6 D Sc degrees have been conferred, 19 M D degrees, 72 M B, and 70 B C.
These figures bespeak the steady growth of the faculties of science and medicine, the numbers in medicine herg larger than in any previous year.

SOCIETIES AND ACADEMIES. LONDON.

Royal Society, June 11 - "On Electrical Evaporation" By William Crookes, F.R S

It is well known that when a vacuum tube is furnished with If its Well known untar when a vacuum tour it accumum to minemal plainum electrodes, the adjacent glass, especially near the negative pole, specify becomes blackened, owing to the deposition of metallic plainum. The passage of the induction current greatly stimulates the motion of the residual gaseous molecules; those condensed upon and in the immediate neighborhood of the condensed upon and in the immediate neighborhood or the condensed upon and in the immediate neighborhood or the condensed upon and in the immediate neighborhood or the condensed upon and in the immediate neighborhood or the condense of the conden bourhood of the negative pole are shot away at an imm speed in almost straight lines, the speed varying with the degree of exhaustion and with the intensity of the induced current. of exhaustion and with the intensity of the induced current. Platinum being used for the negative pole, not only are the gaseous molecules that away from the electrode, but the passage of the current so affects the normal molecular motions of the metal as to remove some of the molecules from the sphere of metal as to remove some of the molecules from the spiner of attraction of the mass, cassing them to fly off with the stream of gaseous molecules proceeding from the negative pole, and to adhere to any object near it. This property was, I believe, first pointed out by Dr. Wright, of Yale College, and some interesting experiments are described by him in the American Journal

ing experiments are described by him in the American Yourney of Science and Arts. The process has been much used for the production of small mirrors for physical apparatus

This electrical volatilization or evaporation is very similar to ordinary evaporation by the agency of heat Cohesson in solids varies according to physical and chemical constitution, thus every kind of solid matter requires to be raised to a certain temperature before the molecules lose their fixity of position and are rendered liquid, a result which is reached at widely different temperatures. If we consider a liquid at atmospheric pressure—say, for instance, a basin of water in an open room—at molecular distances the boundary surface between the liquid and the super-incumbent gas will not be a plane, but turbulent like a a stormy ocean. The molecules at the surface of the liquid dart to and ocean. The molecules at the surface of the liquid dart to and fro, rebound from their neighbours, and fly off in every direction. Their initial velocity may be either accelerated or retarded, according to the direction of impact. The result of a collision may drive a molecule in such a direction that it remains part and may drive a molecule in such a direction that it remains part and parcel of the liquid, on the other hand, it may be sent upwards without any diministion of speed, and it will then be carried beyond the range of attraction of neighbouring molecules and By off into and mingle with the superincumbent gas. If a molecule of the liquid has been driven at an angle with a velocity not sufficient to carry it beyond the range of molecular attraction of

sufficient to carry it beyond the range of molecular attraction of the lequel, it amy still escape, since, in its occasion upwards, a fee lequel is any still escape, since, in its occasion upwards, a temporary wait may be converted into permanent residence. The intrinsact velocity of the molecules is internified by heat and diminished by cold. If, therefore, we make the temporature and the still escape the control of the such case of the lequel are rendered longer and the force of impact greater, and thus the escape of nolecular into the upper region of gas su increased, and we say

that evaporation is augmented.

If the initial velocities of the liquid molecules can be noreased by any other means than by raising the temperature, so that their escape into the gas is rendered more rapid, the result may be called "evaporation" just as well as if heat had

result may be called "evaporation" just as well as it heat has been applied.

been applied.

been applied to the property of t

If a gaseous medium exists above the liquid or solid, it prevents to some degree the molecules from flying off. Thus both ordinary and electrical evaporation are more rapid in a vacuum than at the ordinary atmospheric pressure.

I have recently made some experiments upon the evaporation of different substances under the electric stress,

of different substances under the electric stress. Evolporation of Cadminum—A. U shaped tube was made, Evolporation of Cadminum—A. U shaped tube were at the extremittee of each limb, and in each bulb was asspended from a small platinum hook a small lump of cadminum, the mat-la having been cast on to the wire. The whree were each weighted with and without the cadminum. The tube was exhausted, and with and without the cadmium. The tube was exhausted, and the lower half of the tube was inclosed in a metal pot containing parafilm wax, the temperature being kept at 230° C during the continuance of the experiment. A deposit around the negative pole took place almost immediately, and in five minutes the build surrounding it was opaque with deposited metal. The positive pole with its surrounding fluminosity could be easily seen the whole time. In thirty minutes the experiment was stopped, and after all was cold the tube was opened and the wires weighed The results were as follows .-

Cadmium volatilized in 30 mins. . 7 52 .. Finding that cadmium volatilized so readily under the action of the induction current, a large quantity, about 350 gra., of the pure metal was scaled up in a tube, and the end of the tube containing the metal was heated to a little above the meltung-

Third Senes, vol xii. p 49, January 1877, and vol. xiv p 169, September 1877

point; the molten metal being made the negative pole, in a few hours the whole quantity had volatilized and condensed in a thick layer on the far end of the tube, near, but not touching,

thek layer on the far end of the tube, near, but not touching, the positive pole. Polastikuston of Solver.—Silver was the next metal experimented upon. The apparatus was similar to that used for the calmium experiments. So the solution of the calmium experiments are solution of the sol ment, were as follows --

Original weight of silver	18 14 grs.	24 63 grs
Weight after the experiment	18 13 ,,	24 44 1,
Silver volatilized in 14 hours	. 001	0 19

In this tube it was not easy to observe the spectrum of the negative pole, owing to the rapid manner in which the deposit obscured the glass. A special tube was therefore devised, of the following character—A silver rod was attached to the platinum following character —A silver rod was attached to the platinum pole at one end of the tube, and the administing power has the and the side. The end of the tube opposite the silver pole was at the side. The end of the tube opposite the silver pole was rounded, and the spectroscope was arranged to observe the light, as the silver pole was a silver pole was a silver pole was already to the silver pole to the silver pole was a view of fixed in obstruction to the light, as none was deposited except on the side of the tube surrounding the silver, at a vacuum gwing a dark space of about 3 mm from the silver, a gave a very brilliant spectrum. The spack from silver poles in an was brought into the same, field of view as the vacuum glow, by means of a right angled prism attached to the spectroscope, and the two spectra were compared. The two strong green lines of silver were visible in each spectrum, the measurements taken of their wave-lengths were 3344 and 3675, numbers which are so close to Thakn's numbers as to leave no doubt that they are no close to lankin numers are so leave no cloud that they are the silver lines. At a pressure giving a dark space of 2 mm the spectrum was very bright, and consisted chiefly of the two green lines and the red and the red and cere hydrogen lines. The inter-calation of a Leyden jar into the circuit does not materially increase the brilliancy of the lines, but it brings out the wellincrease the oritinacy of the lines, but it brings out the well-known are lines. At this pressure not much allow fits off from the pole. At a higher vacuum the luminosity round the silver pole gets less and the green lines vanish. At an exhaustion of about one-millionth of an atmosphere the luminosity is feeble, the ailver pole has eracily the appearance in boung red-hot, and the volatilization of the metal proceeds rapidly!

the vointilization of the metal procests rapidly.

If, for the negative electrode, instead of a pure metal such as cadmium or silver, an alloy was used, the different components might be shot off to different distances, and in this way make an electrical separation—a sort of fractional distillation. A negative ciectrical separation—a sort of fractional distillation. A negative terminal was formed of clean brass, and submitted to the electrical discharge in man o, the deposit obtained was of the colour of brass throughout, and on treating the deposit chemically Loyald discrete and control of the c I could detect no separation of its component metals, copper and

A remarkable alloy of gold and aluminium, of a rich purple A remarkable alloy of gold and aluminum, of a rich purple colour, has been kndly sent me by Prof Robert-Auster Gold being very volatile in the vacuum tube, and aluminium almost fixed, this alloy was hiely to give different results from those yielded by brass, where both constituents fly off with almost equal reachness. The Au-Al alloy had been east in a clay tube, in the form of a rod 2 cm. long and about 2 mm in dismeter

in the form of a rod a cin. long and about x mm in diameter.

I have he action producing violations, the "right last" is confined to the superficial layers of molecules only. The most indicately assesses, or confidence of the co

It was scaled in a vacuum tube as the negative pole, an alumnium pole being at the other side Part of the alloy, where it poined the platinum wire passing through the glass, was closely surrounded with a narrow glass tube A clean glass plate was surponded with a narrow glass tube. A clean glass plate was supported about 3 mm from the rod of alloy. After good exhaustion the induction current was passed, the alloy being kept negative. Volatilization was very slight, but at the end of half an hour a faint purple deposit was seen both on the glass plate and on the walls of the tube. On removing the rod from the apparatus it was seen that the portion which had been covered by the small glass tube retained its original purple covered by the small glass tube retained its original purple appearance, while the part that had been exposed to electrical action had changed to the dull white colour of aluminium, Examined under the microscope, the whitened surface of the Austen alloy was seen to be pitted irregularly, with no trace of

crystalline appearance. This experiment shows that, from an alloy of gold and aluminium, the gold is the first to volatilize under electrical influence, the aluminium being left hehind. The purple colour of the deposit on glass is probably due to finely-divided metallic gold The first deposit from a negative pole of pure gold is nurnle then turns to green, which gets darker and darker until metallic lustre of polished gold appears

If we take several liquids of different boiling points, put them under the same presure, and apply the same amount of heat to each, the quantity passing from the liquid to the gaseous state will differ widely in each case

214

It was interesting to try a parallel experiment with metals, to find their comparative volatility under the same conditions of temperature, pressure, and electrical influence. It was necessary to fix upon one metal as a standard of companson, and for this purpose I selected gold, its electrical volatility heing great, and it being easy to prepare in a pure state

An apparatus was made that was practically a vacuum tube with four negative poles at one end and one positive pole at the with four negative poies at one cut and one positive poie at the other. By a revolving commutator I was able to make electrical connection with each of the four negative poles in succession for exactly the same length of time (about six seconds), by this means the variations in the strength of the current, the experiment lasting syme hours, affected each metal alking.

he exposed surface of the various metals used as negative poles was kept uniform by taking them in the form of wires that had all been drawn through the same standard hole in the drawplate, and cutting them by gauge to a uniform length; the actual size used was 0.8 mm in diameter and 20 mm

long.

The comparison metal, gold, had to be used in each experiment; the apparatus thus enabled me to compare three different metals.

The same of time that the current was kept on the revolving commutator in each experiment was eight hours, making two hours of electrification for each of the four negative electrodes; the pressure was such as to give a dark space of 6 mm

The fusible metals, tin, cadmium, and lead, when put into the apparatus in the form of wires, very quickly melted To avoid this difficulty a special form of pole was devised Some small this difficulty a special form of pole was devised. Some small curcular porcelain basins were made, 9 mm diameter, through a small hole in the bottom a short length of iron wire, 0 8 mm. in diameter, was passed, projecting downwards about 5 mm.; the basin was then filled to the brim with the metal to be tested, and was fitted into the apparatus exactly in the same way as the wires : the internal diameter of the basins at the hrim was 7 mm., and the negative metal filed flat was thus formed of a circular disk 7 mm diameter. The standard gold pole being treated in the same way, the numbers obtained for the fusible metals can be compared with gold, and take their place in the

The following table of the comparative volatilities was in this way obtained, taking gold as = 100 ---

	Ť				
Palladium		109.00	Platinum		44'00
Gold		100 00	Copper		40 24
Silver		82.68	Cadmium		31.00
Lead		75 04	Nickel		10 00
Tin		56*96			10.40
Brass		51 58	Iron		5.20

In this experiment equal surfaces of each metal were exposed

to the current. By dividing the numbers so obtained by the specific gravity of the metal, the following order is found :--

Palladium	9 00 Copper	 2.23
Silver Tin	7 88 Platinur 7 76 Nickel	2.02 1.29
Lead	6 6t Iron	 0 71
Gold Cadmium	5 18 Iridium	0 47

Aluminium and magnesiam appear to be practically non-

Volatile under these circumstances.

The order of metals in the table shows at once that the The order of metals in the table shows at once that the electrical volatility in the solid state does not correspond with the order of melting-points, of atomic weights, or of any other well-known constant. The experiment with some of the typical metals was repeated, and the numbers obtained did not vary materially from those given above, showing that the order is

not likely to be far wrong.

It is seen in the above table that the electrical volatility of silver is high, while that of cudmium is low. In the two earlier experiments, where cadmium and silver were taken, the cadmium negative electrode in 30 minutes lost 7 52 grs , whilst the silver negative electrode in 30 minute lost 7 53 grs, whilst the silver negative electrode in 13 hours only lost of 19 gr. This apparent diverginancy is easily explained by the fact (already noted in the electrical disturbance, takes place when the metal 1 v. is or near the point of lispefaction. If it were possible to form a negative pole 100 central disturbance of moltes silver, then the quantity volatilized in a given time would be probably more than that of cadmium Gold having proved to be readily volatile under the electric

current, an experiment was tried with a view to producing a larger quantity of the volatilized metal. A tube was made having at one end a negative pole composed of a weighed brush of fine wires of pure gold, and an aluminium pole at the other

The tube was exhausted and the current from the induction coil put on, making the gold brush negative, the resistance of the tube was found to increase considerably as the walls became coated with metal, so much so that, to enable the current to mass through, air had to be let in after a while, depressing the gauge

9 mm weight of the brash before experiment was 3,5,456 pr. The distone current was kept on the timb for 143 hours at the end of this time the tube was opened and the brash moved. It now weighed 32,5613, showing a loss of 2,932 grs when heated below redness the deposited film of gold was easily removed from the walls of the tube in the form of very brilliant.

After having been subjected to electrical volatilization, the After having been subjected to electrical volatilization, ine appearance of the residual piece of gold under the uncroscope, using a ½-inch object-glass, was very like that of electrolytically deposited metal, pitted all over with minute hollows.

This experiment on the volatilization of gold having produced the control of the control

This experiment on the volatilation of glot naving produced good coherent films of that metal, a similar experiment was good coherent films of that metal, a similar experiment was referring to the table it will be seen that the electrical volatility of platians in such lower than that of gold, but it was thought that by taking longer time a sufficient quantity might be volatilized to enable it to be removed from the tube.

volatilized to chance it to be removed from the three.

The vacuum tube was exhausted to such a point as to give a
dark space of 6 mm, and it was found, as in the case of gold,
that as a coating of metal was deposited upon the glass the
resustance rapidly increased, but in a much more marked degree, resistance rapidly increased, but in a much more marked degree, the residual gas in the tube apparently becoming absorbed as the deposition proceeded. It was necessary to let a little air into the tube about every 30 minutes, to reduce the vacuum. This appears to show that the platinum was being deposited in a porous spongy form, with great power of coduling the residual porous spongy form, with great power of coduling the residual

Heating the tube when it had become this way non-conducting liberated sufficient gas to depress the gauge of the pump 1 mm., metrace sumeters gas to depress the gauge of the pump I mm, and to reduce the vacuum so as to give a doft, space of about the current for ten minutes the tube again refused to conduct, owing to aboroption. The table was again heated, with another liberation of gas, but much less than before, and this time the whole was re-absorbed on cooling. The current was kept on this tube for 25 hours; it was then

opened, but I could not remove the deposited metal except in

small pieces, as it was brittle and porous. Weighing the brash that had formed, the negative pole gave the following results:-

Another experiment was made similar to that with gold and pintanum, but sing silver as in negative pole, the pure metal being formed into a brush of fine wires. Less gas was acceluded during the progress of this experiment than in the case of deposited freely, and the vacuum was easily kept at a dark space of 6 mm. by the very occasional admission of a trace of sir In 20 hours nearby 3 gm of silver were volatilized. The deposited of airser whether the work of the contraction of the c

form of origin tou.

Chemical Society, June 4 — Mr W Crookes, F R S, VicePresident, in the chair — The following papers were read — The
unlocaliar refaction and dispersion of warious substances in soil
tion, by Dr J H Gladstone, F R S. The paper is a continuation
of that laid before the Society in March Ists, and deals with solid
and gaincian substances that have been dissolved in water and other liquids for examination. The results are given in several tables. In the case of organic compounds, the theoretical and tables In the case or organic compounds, the theoretical and experimental numbers are frequently in close agreement Hydrogen chloride, bromide, and nodide give figures for the molecular refraction and dispersion much higher than the sum of the hydrogen and halogen as determined from the paraffin of the hydrogen and naiogen as determined from the paramic compounds, and the values rise as the dilution becomes greater Selenious and selenic acids afford optical values much less than what would be expected from the known values of their con-situents. Metaphosphoric acid does the same The data relating to solutions of salts and alkalies will afford material for a revision of the refraction equivalents of the different metals, and of the electro negative elements with which they are combined.

Ammonia, in contrast with the hydrides of chlorine, bromine, and todine, appears to be uniform in its optical properties, whatever the strength of the solution. The refraction equivalents of cerum, didymum, and lanthanum were found about 12'4. 16 4. and 15 5 respectively The molecular refraction for 124, 16 4, and 15 5 respectively. The molecular retraction for CIO₃ in its sails dissolved in water come-out at about 18 3, that for BrO₃ at 24,9, and for IO₃ at 3,8 —The nature of solutions as elucidated by a study of the densities, heat of dissolution, and freezing-points of solutions of calcium chloride, by S Urckering. The curves representing these properties were examined in the same way as those for sulphuric acid, and similar conclusions are drawn—namely, that changes of curvature, which occur at certain points which are the same whatever property is examined represent the existence of hydrates in solution. The simplest hydrates indicated consist of CaCl, with 6, 7, and 8H₂O. more complex hydrates also exist, as in the case of sulphuric acid—Note on a recent criticism by Mr ydney Lupton of the conclusions drawn from a study of various Sydney Lupton of the concusions drawn from a sawy or various properties of sulphuric acid solutions, by S. U. Pickering. Mr. Lupton (Phil Mag, xxxii 418) applies a single parabolic equation to a portion of one of the author's sulphuric acid density curves, where a change of curvature was supposed to exist, and shows that it represents the results accurately if the experimental error is of a certain magnitude. This magnitude is between error is of a certain magnitude. This magnitude is between 1000 and 10,000 per cent greater than the ascertaned magnitude, and the equation represents all errors of like signs as grouped together. Such a representation cannot disprove the existence of the particular change of curvature, under examinaexistence of the particular change of curvature under examina-tion, still less that of the 101 others examined by the author. The hydrate on which Mr Lupton considers that his investiga-tion throws "very grave suspicion" happens to be the one which the author has isolated in the crystalline condition. In the dis-cussion which followed, Prof. Raminay doubted the validity of Mr cussion which followed; Prof. Raminay doubted the validity of Mr Pickering's methods of differentiating his curves His own experience was that it was impossible to obtain results near than 20 r 3 per cent. to the truth. Dr. Armstrong said that he was prepared to believe in the existence of hydrates in solution, but could not imagine that the 102 breaks in the sulphurio acid curves, for mple, could be interpreted as evidence of as many distinct He was inclined to think that the breaks might be due to change both in the complex water molecules and the sulphuric acid. He was inclined to believe that the hydrate, to which Mr. Lupton's conclusions related, did not begin to form

its point of fusion. Dr. Morley said that a break in the curve should indicate that some new hydrate had just begun to form, should indicate that some new hydrate had just begun to form, but need not show what that hydrate was. Thus, a liquid of but need not show what that hydrate had the head of t curves, which themselves represented the results of other experidrawn, and the scale of the co-ordinates carefully chosen, if the results were to be satisfactory, and probably the conclusions arrived at depended in a large measure on the details of this preliminary adjustment. In the case of the more striking clianges in direction and curvature which were clearly visible in the original curve, the various differential curves did not add much to the information it supplied. He thought that the evidence alforded by these secondary curves of changes of curvature, not otherwise detected, was of the most untrustworthy character Mr Pickering said that Mr Lupton's equation represented the rate of change of the densities as a straight line, while the figure which the actually observed rate of change formed was as different from a straight line as possible. The figures here referred to were the first differential figures (rate of change) deduced directly from the determinations themselves, the question of ducetly from the determnations themselves, the question of the accuracy attentible in differentiating graphs, hasted by Prof Ramasy, did not apply He thought that Frof Armaly hasted by the professional professiona high temperatures The multiplicity and complexity of the hybrates indicated must enhanger the acceptance of his conclusions amongst chemists, and he was perfectly ready to accept any other explanation of the changes with weaks oblitions—

P-thylic au-dimethyl ac diacctylpinnelate and its decomposition-products, by Dr. F. S. Kipping, and J. F. Mackeniae. This paper contains an account of the preparation and pro-This paper contains an account of the preparation and pro-porties of the following compounds this disactly pinetials, as 'disactly pinetials, as' dimethyl as 'disactly pinetiane, as'-dimethyl-a-sectyl caprois, each, as' dimethylylimetic acid, and ethylic-as'-dimethyl pinetials. Volatile platinem compounds, by W Pullinger The author has violated the volatile compounds of platinum with chlorine and carlon monoxide described by Schutzenberger He describes their behaviour when heated in various gases, as they do not completely volatilize, a deter mination of the vapour-density was not possible. He describes a non volatile compound of the formula PiCl₈ C₈O₉, and has also prepared the compound PtBr₂CO Directions are given for the preparation of plannic brounds and iodide, from which it appears that spongy platinum readily dissolves in hot solu-tions of bromine in hydrobromic acid or of jodine in hydrodic acid

in solution until the temperature sank to within a few degrees of

Mineralogical Society, June 16—R II Scott, F.R.S., Preadent, in the chair — The following pagest were rearothe occurrence of supplies a Societal, by From M. Forster Holdle—On the opinal properties of gyrotie, by Frok M. Forster-Heddle—On Frenci's wave-surface, by J. Fletcher, F.R.S.

Lunnean Bonetty, June 18 - Prof. Stewart, President, in the chair — Mr. W. II Bodby exhibited epocasion of *Hieracum protractum* and other plants collected in Sheltand — Mr. Stuart Samuel enhabited a dwarf apeciance of *Ace p Indiantam*, and the plants of the plants o

showed two hybrid Odiningierums: with the parent plants of the parent plants, and the parentage was sub-hybrids out of suported plants, and the parentage was sub-hybrids out of suported plants, and the parentage was sub-hybrids out of the parentage was sub-hybrids and parentage which had been taken from an animal found dead near Forres, N.B. For the purpose of comparison he exhibited some formal heads of the Roe from other parts of Scotland and Germany, and form of the autlers to which Roe Deer were peculiarly and form of the autlers to which Roe Deer were peculiarly liable.—A paper was then read by Mr Spencer Moore on the true nature of Callui, and no continuation of former remarkson the time nature of Calluri, and in continuistica of former remarkson the mean subject (Lann Soc Journ, 1887, vol. xxvii.), Not 1852, 1853, He showed that the outer never-plates of the fig are obligarated by a substance giving all the day reactions of Calluri, which does not perponner and will not yield protect reactions. Many protect Calluria which continuistically the protect of Calluria of the vegetable marrier. It appeared that the calluria would dissive in an solution of gammabic, but whether by agency of a ferment or of an and he had not yet determined.—A second paper by Mr. Spencer Moore dealt with the alleged existence of protein in the spalls of the transport of the control of the co

Academy of Sciences, June 22—M Duchartre in the char — Method for the determination of the equatorial co-crimates of the centres of the plate which are to food in the control of the plate which are to food in the generalization of equation, relating to the theory of the functions of a complex warnable, by M. Emil Picard — On the determination of the mechanical equivalent of fast, by M. Marel Deprex. At the meeting of June 8, M. Micalesco described an apparatus he had employed for determining the mechanical equivalent of the st. It is now recarded that the area methody as employed. heat. It is now remarked that the same method was employed by Hrm in the experiences made by him in 1860, and in latter years by M. d'Arsona's—On the formation of the leaves of first vessels, by M. A. Tricul —On the apparent and real glycolytic fermentation in the blood, and on a rapid and exact method of estimation of glycogen in the blood, by M. R. L'ptime method of summotion of glycogen in the blood, by M. R. L'ptime and the state of the state of the state of the state of the dimensions, by M. E. Mercadatr—Observations of the new sateroid discovered at Nice Observatory on June 11, by M. Charlon. Observations for position were made on June 11 and the state of the dimension of the state exercise makes. A MyM. Kam-13 — Observations of the same asteroid made at Algiem Observations with the telescope of o g metre aperture, by MM Ramband and Sy. Observations for position were made on june and Sy. Observations for position were made on june as an abstract of the control o fails to obtain metallic barium; with the pure sait an infastible body of high resistance is deposited; with the mixed salts chlorine is disengaged at the anode, and, from the results of analyses given, it would appear that among the products of the electrolysis some subchloride must be formed.—The calculation of the temperature of ebullition of any liquid whatever, under all pressures, by M G Hinrichs — Action of heat on solutions of chromium salts: green salts of chromium, by M A. Recoura.— The constitution of the green chromium salts is elucidated by means of the results of experiments following thermochemical methods.

—Researcher on osmium, osmiamic acid, and osmiamates, by M —Researchêno comuum, comsame sod, and consumates, by M. Joly Taking the resisted atomic weight of comsum, the analyses of Prizzobe and Survey, as well as those of the author, and the survey of th

—On the bromo-sodides of stilcium, by M A Besson,—On the cyanogen compounds of magnesium, by M, Racoll Varet.—On the action of nitrice and of different degrees of connectration the action of nitrice and of the connectration of the connectration of the connectration. The strong of the connectration of the connectration. The action may proceed in two ways—11 of the connectration. The action may proceed in two ways—11 or and without evolution of gas. The alter corresponds to what is known as the passive state of iron.—Action of sodium ben-yield upon the connectration of the connectration of the connectration of the connectration of preservation of national connectration of many departs and integration of preservation of national connectration of national connection of national connectration lopment of blastodermic leaves in Crustacea Isopodes (Perestlia scader), by M. Louis Roule.—On the disengagement of oxygen by plants at low temperatures, by M. H. Jumelle It appears that in plants capable of resisting excessive humidity or cold the decomposition of carbon dioxide may continue at very low temperatures, even when respiration has ceased. Confers such temperatures, even when respiration has cased. Conifers usof as the pauper-rec, and a lichen (Evenus primaturi), in light on assumitate the earlien in the sur in an atmosphere having a term, and the surplement of the conference bones of chimpanzees, gorillas, and orang outangs, by M Euenne Roller

CONTENTS.	PAGE
Crystailography. By Prof John W Judd, F R S. Photography in Colours. By Prof. R. Meldola	, 193
F.R.S	194
Our Book Sheif	
Graham · "Geometry of Position"—Alex. Larmor Trelease "The Species of Epilobium occurring	
North of Mexico "-J. G. B	196
Sargant and Wishaw . "A Guide Book to Books"	196
Johnston "Tasmanian Official Record, 1891" .	196
Letters to the Editor:-	
The Albert University -W T Thiselton Dyer	
C M.G , F R S	. 197
F R.S	
Force and Determinism. (With Diagram)-Evan	197
McLennan, Prof. Oliver J. Lodge, F.R.S.	198
The Scorpions at the Zoo -R I. Pocock	198
Cetaceans in African Lakes -V. Ball, F R.S	198
On some Points in the Early History of Astronom	
V (Illustrated.) By J Norman Lockyer, F.R.S.	199
The Later Larval Development of Amphioxus	*99
(Illustrated.) By Prof E. Ray Lankester, F.R.S.	202
The Cardiff Meeting of the British Association. By	
R. W Atkinson	204
The Marine Biological Association of the United	
Kingdom	205
University Extension Students at Cambridge .	205
Norman R. Pogson, C I.E. By W E. P	205
Notes	. 206
Our Astronomical Column:	
The Capture Theory of Comets	200
Wolf's Periodic Comet (b 1891)	. 209
Yoruba and Gazaland	209
The Condition of Space By Sydney Lupton	210
The Flowers of the Pyrences and their Fertilization	
by Insects. By Prof. J. MacLeod	
University and Educational Intelligence	
Societies and Academies	. 212

THURSDAY, JULY 9, 1891.

THE UNITED STATES ENTOMOLOGICAL COMMISSION.

Fifth Report of the United States Entomological Commission on Insects Injurious to Forest and Shade Trees By Alpheus S. Packard, M.D., Ph.D

TERY valuable Reports have been presented by the United States Entomological Commission from time to time. Among these may be mentioned that upon "The Rocky Mountain Locust," prepared by Prof. Riley in 1878, which is a most exhaustive record of the habits of this terrible pest, and of methods of prevention and remedies against its attacks Later on, an equally valuable and instructive Report was submitted with regard to the cotton worm (Aletta argillacea), very destructive to the cotton plant, whose crop it has reduced in some seasons from 30 to 75 per cent in the principal cotton-producing States. Both these elaborate works, as might be expected from their authors, Prof Riley and Dr. Packard, who practically constituted this Entomological Commission, are full of interesting experiments, ingenious contrivances, and subile devices, to circumvent the insect hordes advancing with the insistance of invading aimies.

This Report upon "Insects Injurnous to Forest and Shade Trees" is perhaps not so exciting or painfully interesting, as the harm caused to trees is not so directly felt as that occasioned to various food crops and other crops of the field by locusts and caterpillars innumerable, and the name of the insects described therein is legion, and their individual mixcheft is comparatively small

As Dr Packard says, "a volume could be written on the insects invigo on any single kind of tree, and hereafter it may be expected that the insect population of the olds, elim, popular, pine, and other trees will be treated of monographically." Kaltenbach, in "Die Pflannenfemde, and ser Klasse der Insekten," gives accounts of 537 European species of insects injurious to the oak, 107 to the elim, and 396 to the willow. Perris, a French observer, has recorded no less than 100 species of insects found upon the maritime pine.

The attacks of insects upon forest trees and upon shade trees, or trees planted for shade and ormanentation in parks, streets, and other public places, are becoming far more numerous and serious, just as in the case of all cultivated crops under the sun. In the United States these attacks are creating intense interess, as the forests are of the highest commercial importance, and have been extensively decreased by clearing, by wanton and accidental fires, and other causes. This Report, then, is opportune, and must be of great service, as it demonstrates the sources of the influres, and suggests means of preventing them or of dimunishing them.

The French, German, Austrian, and Italian Departments of Agroculture are giving much attention to this subject, for it is found that the forest trees of these countries are becoming more liable to harm from insects. In Great Britain some kinds of trees, notably of the pine tribe, have suffered much damage from insect intherto unknown, or, at least, not reckoned as injurious.

There are, without doubt, many others unsuspected in British woods and forests, slowly but surely working great mischief.

Dr. Packard shows that trees are attacked in every part and in every conceivable manner by insects. Their roots, leaves, bark, fruit, and twigs are all more or less subject to their visitations The most curious of those which affect the roots is the "seventeen year" Cicada, whose larvæ remain for over sixteen years attached to the rootlets of the oak, other forest trees, and fruit trees, as the pear and apple According to Prof Riley, these larvæ are found at a great depth, sometimes as much as to feet below the surface The female, resembling a locust, deposits long slender eggs in an unbroken line upon the terminal twigs of oak and other trees in May and June Sometimes the twigs are so "badly stung by this ovinosition that the trees are seriously injured. The length of wood perforated on each branch sometimes varies from one to two and a half feet, averaging probably eighteen inches, and appearing to be the work of one female. From the eggs the larve hatch out in six weeks and drop to the ground, in which they live, sucking the roots of the trees for nearly seventeen years, the pupa state lasting but a few days

A formidable enemy of the "live-oak" (Quercus virens) is an enormous beetle, Mallodon melanopus, Linn , whose larva, three inches long and an inch in thickness, bores into the roots upon which it lives. As a result of the work of this insect in South Georgia and Florida, " vast tracts, which might otherwise have become forests, enriching the ground with annual deposits of leaves, are reduced to comparatively barren scrub, in which the scattered oak-bushes barely suffice to cover the surface of the sand" The eggs are laid by the beetle in the foot, or collar, of the tree, just below the surface of the ground. It is not known how long the larvæ live, but their life must extend over several years, "since the roots occupied by them grow to a large size, while they show an abnormal development, and become a tangle of vegetable knots In fact, the entire root in its growth accommodates itself to the requirements of the borer within" The effect on the tree is to kill the original stem, which becomes replaced by a cluster of insignificant and straggling suckers, forming, perhaps, a clump of brushwood.

Among the tree-borers, other than beetles, the oak "carpenter worm," the caterpillar of Prionoxystus sobima, Peck, is the largest and most destructive. It is larger and far more abundant than the European caterpillar of Cossus ligniperda, or goat-moth, belonging to the same family of Cossidæ, but it sinks its tunnels deep in towards the heart of the tree, not confining its mischief to the limbs and large branches like the goat-moth caterpillar. Fitch says of this .- " Of all the wood-boring insects in our land, this is by far the most pernicious, wounding the trees most cruelly. The stateliest oaks in our forests are ruined, probably in every instance where one of these borers obtains a lodgment in their trunks." Another species of Cossus, known as Cossus centerensis, bores into poplars. Its appearance and habits also resemble those of the goat-moth, well known in this country

There are numbers of boring beetles, of the families Buprestide, Cerambycide, and Scolytide, whose larvæ

make burrows, passages, and galleries in trees, mainly just under the bark. Of these, the elm-tree borer, Saberda tridentata, is prominent, often killing elm-trees by wholesale, both in forests and in public parks. The larvæ bore in the inner bark, making irregular furrows and tunnels upon the surface of the wood, which "is, as it were, tattooed with sinuous grooves, and the tree completely girdled by them in some places." In the State of Illinois attention was attracted to the gradual decay and death of white elms (Ulmus americanus) in rows in some towns The leaves fell off in the summer, and some of the branches died. Finally, the tree perished altogether. On peeling off the bark, half-grown larvæ of Saberda tridentata appeared in considerable numbers. and the manner in which the bark had been mined by the Saperdas gave sufficient evidence of the cause of the death of the tree. Prof Forbes, State Entomologist of Illinois, says: "From the present appearance of the elms throughout the towns of Central Illinois, it seems extremely likely that this pest will totally exterminate this tree, unless it be promptly arrested by general action." It is recommended that all affected trees should be removed and destroyed in autumn and winter. before the beetles have a chance to emerge from the trunks. This beetle is not quite an inch long, its larva is rather more than an inch in length, having a large flat head.

Fir trees, especially the white pine (Psnus strobus), the yellow pine (Pinus mutis), and Pinus rigida. are much injured by the pine borer or "sawyer," Monohammus confusor. "I have seen," writes Dr. Packard, "hundreds, perhaps nearly a thousand, dead firs, whose trunks were riddled with the holes of these borers." Dr. Packard cites a correspondent of the North-Western Lumberman who reported that "extensive and valuable forests of vellow pine in the Southern States are destroyed by a worm commonly called here a 'sawyer,' or flat head" White pine trees are also much heset by the "wood engraver" bark beetle (Xyleborus xylographus, Fitch), so called because it makes beautifully regular and artistic furrows on the surface of the wood under the bark It is the most common, and probably the most pernicious. of all the insects that infest the forests of white pine in New York State, and of yellow pine in the States south of New York.

A weval, the white pine weval (Pixvodes stroot), frequently spoils the finest white pines in parts of America by placing numerous eggs in the bark of the topmost aboots off fit retes; the larve from these make mines in the wood and pith, causing the shoots to wither and die, thereby occasioning a fork, or crook, at this point. This is a very small insect, not three-quarters of an inch long, and the larve are no thalf as inch in length.

There is a mighty almy of caterpillars of various moths described in this Report, which devoor the foliage of trees of all kinds-in American forests and gardens Several species of Clinocampa and Gasterogacha, of the Bomby-cida, assail oak, willows, ash, chestnut, apple, and pear trees. These are termed "tent" caterpillars, as they live in webs of a tent-like form, as the Clisocampa Neustria, or lackey moth, in Europe. But the most voracous of categoliars are the "fall web worms" of the moth hypatartria curve, Drury. For instance, in 1886, the

city of Washington, as well as its vicinity, was entirely overrun by them. All vegetation, except that not agree-able to their tasses, suffered greatly. Fine rows of shade trees, which grace the streets and avenues, were leafless in midsummer, and covered with hairy worms. The payements were strewn with modellings of the caterpillars and their webs, which were blown about unpleasantly by the wind.

Because they are hairy they have comparatively fee enemies, among birds at all events. The "English sparrow." Fast becoming as great a nusance in the United States as the rabbit in Australasia, will not look at them, and has driven away by its pugnacity many burds that would eat them Fortunately there are insect enemies which prey upon them, as the Mantis carolina, or "rear horse," an extraordinary insect of the same family as the "praying" mants, and the "wheel bug" (Prioundus cristatus). Several parasitic insects also greatly check the spread of this moth. One by, Telenams bightus, Riley, lays its egg within the tiny egg of the moth, in which all the transformations of the fly take place, and its food and lodging are found. In due time, having cleared out the ear, the five merges.

Mr. Bates, in his graphic account of tropical insects, has pictured many that are made to closely resemble their surroundings, for their preservation and other purposes. In his well-known paper on minurcy, he alludes to the insects known as Phasimidae, or "spective" macets, as especially typical of this adaptation to circumstances, preserved and augmented, as Darwin says, "through ordinary selection for the sake of protection." Mr Wallace brings forward the Phasimidae as striking instances of minurcy, remarking that "it is often the females alone that so strikingly resemble leaves, while the males show only a rude approximation."

Species of this family of Phasmidæ are mischievous to trees in America, principally the oak and the hickory. The chief of these is the Diapheromera femorata, Say popularly called "walking-stick," "walking-leaves," "stick-bug," " spectre," " prayrie alligator," " devil's horse," This insect, especially the female, is so like the twigs of trees in colour and appearance, that it is difficult to discover it. It has a habit, too, of stretching out the front legs and feelers. greatly enhancing this re semblance. While the vegetation is green the " walking-sticks " are green; when the foliage changes in the autumn they also change colour; and when the trees are bare of leaves they closely resemble the twigs on which they rest. The eggs are dropped upon the ground from whatever height the females may be, "and, during the latter part of autumn, where the insects are common, one hears a constant pattering, not unlike drops of rain, that results from the abundant dropping of these eggs, which in places lie so thick among and under the dead leaves that they may be scraped up in great quantities." Prof. Riley adds, with regard to these singular creatures and their wonderful resemblance to the oak vegetation upon which they occur, "one cannot help noticing still further resemblances. They are born with the bursting of the buds in the spring; they drop their eggs as the trees drop their seeds, and they commence to fall and perish with the leaves, the later ones persisting, like the last leaves, till the frost cuts them off."

There is not space enough to do more than allude to the sawfiles, another class of insects fearfully injurious to trees of divers kinds Many of these Hymenoptera, as in Great Britain and other European countries. mainly of the genus Nematus, clear off the leaves of forest and fruit trees. Others attack firs, notably some species of Lophyrus and Lyda, as the Lophyrus abietis, Lophyrus pinetum, and Lophyrus pini-rigida, and some of the Lyda. Cameron, in his monograph of the British phytophagous Hymenoptera, states that there are fifteen species of Lophyrus in North America, and that the species of Lyda are common there

Lophyrus abietis and Lophyrus abbotu appear to do the same harm in America to firs as the I ophyrus pini in Scottish fir plantations, whose larvæ not only eat the leaves but the bark of the young shoots, frequently occasioning great losses

An instructive account is given in this work of the effect of temperature upon insects. It is the fashion in Great Britain to say that insects are killed by hard frosts But they are not killed in countries-as America, for examplewhose winters are far more severe Dr Packard, quoting Judeich and Naitsche's "Lehrbuch der Mittel-Europaischen Forstinsektenkunde," observes that " the influence of even very great cold on the normal hybernating stages of our insects is not very great. In the summer of 1854 the 'nun' moth had very generally laid its eggs in Eastern Prussia uncovered on the bark, and these did not freeze in the hard winter of 1854-55 According to the observations of Regener, openly exposed caterpillars of the pine silk-worm endured 10° F The pupa froze at 21' F. the moth at 10 F. According to Duclaux, the eggs of the silk-worm endure well, remaining two months in a temperature of 17° F Great fluctuations of temperature during the winter produce an abnormal interruption of the winter's rest or hibernation, and thus cause the death of many insects" It will be noticed that in all these cases the insects were unprotected, whereas there is generally some kind of protection during the winter for insects in all stages, provided by their instinct.

Not the least useful part of the Report is that treating of remedies for insect attacks, and machines and envines for applying them Arsenical poisons, known as Paris Green and London Purple, are strongly recommended for spraying or syringing trees infested with the larvæ of beetles and sawflies, or the caterpillars of moths. These have been recently introduced into England, being advocated by the Board of Agriculture, but have not been extensively adopted yet, owing to the natural prejudice against the use of poisons. In America they are employed most extensively and with the greatest benefit By means of these the potato beetle (Doryphora decemlineata) was circumvented, and the cotton and boll worms checked, and the onslaughts of many other insects materrally lessened. For Aphides, Scale insects, and other insects which suck the sap of leaves, "emulsions" or washes of soft soap, or "jelly soaps," made directly from fish oil and concentrated lye, or whale-oil soap, are prescribed Also kerosine, naphtha, and petroleum, applied in a fine spray, or mixed with soap and soap jelly, forming "emulsions." These remedies act by contact, being applied principally to insects which do not eat the leaves as well as by making the surroundings unpleasant and solved; everything else is mere child's play.

unbearable. Powdered substances, as pyrethrum, hellebore, and sulphur, are not much employed for forest work, but cases frequently arise warranting their use in a limited way Hellebore, as gooseberry growers in Kent and Cambridgeshire well know, is of especial value against all sawfly larvæ Sulphur is valuable against the red spider (Tetranychus telarius), and is used alone or in connection with emulsions of kerosene.

Numerous machines are in vogue for putting on washes and powders, from the small "knapsack" machine carried on the back to have tanks on wheels, fitted with powerful hand-pumps and long lengths of hose, through which liquids are forced to great heights, for very high trees, tall ladders are used, which are set near the trees, upon which men mount, and direct the hose into the copmost branches For smaller trees and shrubs, a barrel fixed on wheels, having a good force-pump with hose, is adopted Pumps are also fitted into tanks of all shapes and sizes, and moved from place to place by hand or horse-power. To distribute the liquids there are endless nozzles or jets contrived with much ingenuity to send forth fine mists. or sprays, or continuous volumes It will suffice to say that the best of these is the cyclone, or Riley nozzle, which is just being introduced into Great Britain

Foresters, and all concerned in the management of woods and forests, public parks, and gardens, would do well to consult this work for information as to the various insect enemies of trees, and the best means of dealing with them. It is quite impossible in a review to give anything more than a general idea of its scope and nature

PHYSICAL RELIGION

Physical Religion The Gifford Lectures delivered before the University of Glasgow in 1800 By F Max Muller (London Longmans, 1891)

HE present volume, which embodies the author's second course of Gifford Lectures, with notes and appendices, is devoted to the consideration of "Physical Religion," that is the religion which finds its object the Infinite in or behind the phenomena of Nature The author's previous writings have made it clear that for the simplest and most abundant manifestation of this form of religion we must go to the Veda, so his first task in the lectures before us is to tell once more the familiar story of the discovery, the character, and the age of the Veda To this survey four lectures are devoted, and, in conclusion, the author-not without duly considering all that in recent years has been urged to the contrary-reattirms his conviction that the hymns of the Rig Veda cannot have been collected later than 1000 BC

In the sixth lecture the author deals with the evolution of the idea of God It is often supposed-even by philosophers of repute-to be a sufficient account of the earliest form of religion to say that men worshipped stones and other fetishes as their gods But, as the professor well remarks-

"Does it never strike these theorizers that the whole secret of the origin of religion lies in that predicate, their gods? Where did the human mind find that concept and that name? That is the problem which has to be

And he exhibits the process by which Agnı (the Vedic god of fire), from being originally nothing but "the mover," came to be called deva; and it is this word deva which when examined yields the clue to the development. and teaches us a lesson of the highest importance .-

220

"Guided by language we can see as clearly as possible how, in the case of deva, the idea of God grew out of the idea of light, of active light, of an awakening, shining, illuminating, and warming light. We are apt to despise the decayed seed when the majestic oak stands before our eyes, and it may cause a certain dismay in the hearts of some philosophers that the voice of God should first have spoken to man from out the fire. Still, as there is no break between deva, bright, as applied to Agni, the fire, and many other powers of nature, and the Deus opti-mus maximus of the Romans—nay, as the God whom the Greeks Ignorantly worshipped was the same God whom St. Paul declared unto them-we must learn the lesson, and a most valuable lesson it will turn out to be, that the idea of God is the result of an unbroken historical evolution, call it a development, an unveiling, or a puri-fication, but not of a sudden revelation."

The two following lectures are devoted to the detailed following out of the biography of Agni, who appears in a variety of characters as the sun, the fire on the hearth. lightning, the messenger between gods and men, and priest. Finally, divested of his material character altogether, he is raised to a sublimer level as creator, ruler, and judge. The value of this inquiry, into the details of which we have no space to enter, lies in the fact that it involves the refutation of two objections which are frequently urged-with or without knowledge-against natural religion by the professors of so-called supernatural religion. The first is that natural religion, though it may lead men to a conception of "gods," is powerless to suggest to them the conception of God. This is directly contradicted by the history of Agni, whom we can watch, as it were, passing through many stages of growth until he becomes in the end "a supreme god, the Supreme God, till his very name is thrown away, or is recognized as but one out of many names by which ancient seers in their helpless language called that which is, the One and All" Driven from this position, however, the orthodox objector usually takes up another, and contends that the supreme God of natural religion lacks some if not all of the lofty attributes which he is enabled to know and to predicate of his own God by supernatural revelation But Prof. Max Muller's answer to this objection is equally decided .-

"Trusting to the fragments that have been preserved to us in the Veda, to the remains of the most childish as well as the most exalted thoughts, we may say that natural religion, or the natural faculties of man under the dominion of the natural impressions of the world around us, can lead, nay, has led man step by step to the highest conception of deity, a conception that can hardly be surpassed by any of those well-known definitions of deity which so-called supernatural religions have hitherto claimed as their exclusive property

In the ninth ecture the Professor leaves for a while the field of his special studies to glance at the history of religious ideas among other peoples than the Aryas of the Veda. And it is noteworthy that he fully recognizes the pogsibility that Jehovah himself may originally have been

which he alludes to Abraham, the legendary founder of Hebrew monotheism, as if his historical character had never been questioned. It is, of course, perfectly open to any one to believe that Abraham was a real individual. who received a "revelation," whatever that word may be defined to mean (see p. 221); but at the same time, in a course of lectures addressed to an academic audience, it should surely have been mentioned that this is an hypothesis, which Renan, for instance, among Semitic scholars. does not even take the trouble to discuss

In the lecture on the mythological development of Agni, we would call attention to the importance assigned to riddles as a cause of the growth and preservation of mythology. To take a simple example

" After the Arvas in India had once arrived at the conception that fire was apt to consume the fire-sticks, or that Agni had eaten his father and mother, they seem to have amused themselves by asking such questions as, Who eats his own parents? The answers given would then enter upon many details, more or less far fetched, and the question would continue to be asked between young and old people "

And we think that this is a far more natural explanation of the origin and popularity of such stories than the hypothesis, which has no external evidence to support it, that the Aryas were simply ascribing to Agni the atrocitles which they practised themselves

Finally we come to the question, What can a study of natural religion teach us? "Why," answers Prof. Max Muller, "it teaches us that religion is natural, is real, is inevitable, is universal," and he proceeds to exhibit in detail one or two of the more important implications of this great lesson. With regard to miracles, for instance -

"Is it not clear that in the eyes of those who believe in the omnipresence of the Moral Governor of the world, miracles, in the ordinary sense of the word, have become impossible, and that to them either every event is miraculous or no event can claim that name Before the great miracle of the manifestation of God in nature, all other miracles vanish. There is but one eternal miracle, the revelation of the Infinite in the

The Professor then shows by a series of examples that the tendency to ascribe a miraculous birth to the founders of religions is natural and widespread, and asks by what right people claim a different character for the legends of the birth of lesus than for the similar legends told of Buddha and Mohammed The honesty and candour with which the question is stated are specially welcome at the present time, when it is becoming the fashion with ecclesiastical amateurs in Biblical criticism to blow hot and cold, as it were, with the same infallible mouth-that is, to reject the miracles of the Old Testament, but retain those of the New For instance, in a recent manifesto, highly recommended as providing a temporary shelter for the destitution of the semi-reasonable, there is, on the one hand, some tall talk about the imaginative performances of "a dramatizing Jew" in the Old Testament, while, on the other hand, we are gravely informed that "the Church can insist upon the truth " of all that is recorded in the New Testament That this cheap substitute for criticism will eventually be discredited, even in England, we have no a doubt whatever. Meanwhile we cordially recommend the present volume not only for the interest of its subjectmatter, but as an example of the masterly application of the only method which in these inquiries can lead to sure results.

THE KARWENDEL ALPS

Das Karwendelgebirge Von A Rothpletz Separat-Abdruck aus der Zettschrift des Deutschen und Oesterreichtschen Alpenvereins. With Map. (Munchen, 1888.)

THE Karwendel Alps are a mountain mass lying to the north of the valley of the Inn, between Innsbruck and Jenbach, and bounded on the east by the horbach and benached the last and the south roughly by a line drawn along the Hantanalid (the highest part of the valley of that river) to Schwas, in the Innihal This region has been explored and mapped by Herr Rohlpetz, with the assistance of other workers, and it is described as consisting of three roughly parallel ranges. Though their peaks do not attain to a very great elevation, the higher summits ranging from Soo feet to rather over \$200 etet, their grand cliffs of cream-coloured limestone and their pine-clud slopes afford very beautiful scenery.

In this part of the Alps the mountain masses are wholly composed of sedimentary deposits which range from the Trias to the Neocomian The oldest are the Werfener Schichten, a mass of sandy shales and sandstones, often containing numerous flakes of biotite, indicative, in all probability, of the denudation of the crystalline masses which form the floor of the Mesozoic rocks in the Alpine region. They correspond in age roughly with the upper part of the Bunter in Germany and England Then comes the remainder of the Trias, including the Muschelkalk, followed by the representatives of the Rhatic, the Lias, and other Jurassic deposits, and a part of the Neo comian, a marine series from top to bottom. Neither the last nor the Jurassic system attains to a great thickness, but both the Rhætic and the Trias are represented by great masses of rock In the one, the Haupt-dolomit occasionally attains to a thickness of 500 metres; in the other, one member, the Myophorienschuhten, is said to be equally important Careful descriptions of each subdivision, with lists of the more characteristic fossils, are given in the memoir Neither Cretaceous nor Fertiary strata occur to bridge over the interval between the Neocomian and the superficial Glacial or post-Glacial

The physical history of these ranges is made the subpict of an elaborate discussion. Herr Rothplets is of opinion that, at some epoch after the Neocoman and before the commencement of the folding process by which the existing Alpine ranges were upraised, the region was affected by movements which produced a system of faults. In consequence of these, a zone of upheaval was bordered on either side by one of depression. These caused important modifications in the great east and west folds, to which the Eastern Alps are due; the rocks in the two troughs were crushed together, the upheaved tracts were upthrust. A folding plate represents an ideal section of the region after the "piesents an ideal section of the region after the "pieAlpine" movements, side by side with one which shows its present state

There can be no doubt that, in explaning the physical structure of the Alps, we have to take account of much more than the later Tertuary foldings to which the formation of the mountain-chain is die, such as the odd in the pre-Mesonic land-surface, and any important system of faults could not fail to produce varianted effects. Also, it seems indubtable that there were interruptions to the downward movement in parts of the Alpine area during the later Mesonic and the earlier Tertuary times, which may, very probably, have caused faults such as are described by Herr Rothpletz. These, it may be noticed, appear to run obliquely to the general trend of the main folds

Herr Rothplets, in conclusion, expresses an opinion adverse to those geologists who consider that glacters have played an important part in the crosson of valleys, and calls especial attention to the Soensee, a small lake lying in a fold of the Plattenkalls, which, in his opinion, indicates that "the movement of fleutre acted in this case with greater rapidity than the elosive action of streams or glacter".

The geological map is on a scale of 1, 50,000; the separate memoir, of octavo sive, contains 76 pages, with 9 plates and 29 smaller illustrations. It also includes a full list of works bearing on the district. So far as we can judge, it is an elaborate and valuable contribution to the knowledge of a region but little known to English travellers, who, however, occasionally pass very near to it along the migran of the beautiful Achensee

TGB

OUR ROOK SHELF

Graphical Status - Two Freatises on the Graphical Calculus and Reciprocal Figures in Graphical States - By Luigi Cremona - Translated by Thomas Hudson Beare, Professor of Fingmeering and Applied Mechanics, Heriot-Watt College, Edinburgh, (Oxford, Clarendon Press, 1890).

I REALINE on this and allied subjects of the Graphical Calculus are not uncommon in our language, but, although nowadays indispensable for engineering purposes, the subject does not flourish in our theoretical courses of instruction.

The theorems of Graphics once stated—that is, drawn out carefully on the drawing board—are obvious, or at least do not lend themselves to verbal written demonstration, so that for purposes of competitive examination, the controlling influence of modern education, the subject of Graphical Statics and Calculation is useless

Geometrical drawing is not taught in our public schools and Universities, and the student in a technical college only requires the bare minimum of Graphics, sufficient to enable him to pass on to practical development; so that we fear the elegant abstract theorems on the use of significant of the control of equations, centrods, rectification and graphical analysis generally, will receive but sight attention.

There is a note of defance in the Author's Preface to the English edition of "Reciprocal Figures in Graphical Statics" (the second treatise) "At a time when it was been also been also been so engineering could be solved by mathematical analysis only, Culmann's genus suddenly created Graphical Statics, and revealed how many applications graphical methods and the theories of modern (projective) geometry possessed," &c.

The preface to "Geometry of Position," by R. H. Graham, must be consulted for the counterblast in favour of Maxwell's claim to the honour of priority.

The History of Commerce in Europe. By H. de B. Gibbins With Maps. (London: Macmillan and Co. 1801.)

THE chief defect of this little book is that the author does not bring into sufficient prominence the geographical element in commercial history. What are the geo-graphical conditions which have favoured the growth of particular industries in special localities? And in what ways have such conditions affected the interchange of commodities between one part of the world and another? Mr Gibbins has not, of course, neglected these questions, but he scarcely seems to have realized that they are of out its exercity seems to have realized that they are of vital importance for the scientific presentation of his subject. On the other hand, his appreciation of the action of historical causes in the development of commerce is excellent; and for a general view of commercial progress his manual will be of much service to students. After an introductory chapter he considers " ancient commerce." by which he means the commerce of the Phoenicians, the Carthaginians, and the Greek colonies. He then deals with the ancient Greek States and Rome as trading communities. Next comes "mediæval commerce," in connection with which he has much that is interesting to say about the Italian cities, the Hansa towns, medizeval trade routes and fairs, the manufacturing centres of Europe, and other topics Under "modern commerce" he treats of the commercial empires in the East, the commercial empires in the West, English commerce from the sixteenth to the eighteenth century, European commerce in the seventeenth and eighteenth centuries, the industrial revolution in England and the Continental wars (1793), modern English commerce, and the development of commerce in France, Germany, Holland, Russia, and the other European States. The maps are very good, and add considerably to the value of the text We may also note that the volume includes a useful series of questions on the various chapters, and two appendices, in one of which there is a list of British produce and manufactures in 1840 and 1889, while the other consists of a table showing the present colonial empires of European Powers.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions ex-pressed by his correspondents. Nisther can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communication:

The Albert University

The Albert University of her members of the the first course of the first cour

inversity and King's Colleges So long as the matter was in the hands of the Commission, this charter, put forward by the Councils of the two Colleges, was merely one of many suggestions as to the proper form which a new or reconstituted University of London should take. It was notorious that the Councils' support of Sir George Young's scheme did not represent the attitude either of the Professors of the two Colleges or of those throughout the country who have special knowledge of Universities and of the best methods of academical organization.

inquiry into the draft charter propounded by the Councils of

The Royal Commission of 1888 was appointed to inquire ed for the advancement of higher education in The Commission took a large amount of evidence from interested parties—practically none from persons outside the London institutions concerned—and recommended that the University of London should be invited to meet the needs set forth in such documents as the draft charter of the Albert University, by some modifications of its constitution and procedure. In the event of a failure on the part of the University to do this, the Commissioners recommended that the matter should be

referred back to them My sup ort of the claim of University and King's Colleges to be incorporated as some kind of University has always depended on the assumption that no Commission or other serious authority on the assumption that no Commission or other serious authority could possibly seccede bindily, and without full consultation of the best authorities in the land, to the scheme embodied in the Albert University draft charter. The Commissioners took, it seems to me, the only rational view of that charter—namely, that it might serve as a suggestion to the University in Burlington Gardens for a reform which would meet, at any rate, some of the objections raised to the existing constitution of the latter

body body
Lord Cranbrook, however, seems anxious to burry on the
shelwing if not the solution of the University of London question.
Instead of referring the matter back to the Commissioners, he
takes the matter out of their hands. The Commissioners have
never reported in anxioner to the question at bifore them. No
one knows whether they think any, and, it so, what kind of

new University is required in I ondon.

Having failed to actile the question for the time being by such a reform of the University in Burlington Gardens as Mr. Dyer a retorn to the University in purington carteens as on; Jyer advocates, the Commissioners ought—according to their own recommendation—to have been allowed to proceed further "It is now ascernage," they would have said, "that the existing University of London will not reform uself in the way we have suggested what not of University shall we now recommend, if any?" They might have suggested the coercion of the Convocation of Burlington Gardens by an Act of Parliament; or they cation of burington varieties of an Act of ranament; for unight have—after inquiring from authorities in Oxford, Cambridge, Dublin, Edinburgh, and wherever else some understanding of the nature and objects of Universities happens by chance to dwell—recommended the formation of a professorial University in London similar to those of Scotland and of

Germany.

I confess that it has always been my hope, though not my expectation, that they would take the latter course. I am sure that if they had proceeded to take the evidence of experts in University matters, and had not attached undus importance to

I guite agree with Mr. Dyer that it is little short of monstrous for the Government to set up in London two such organizations as Burlington Gardens and the federal Albert, there is the strongest reason for insisting that there shall be only one of them, whether Convocation like: it or not

Meanwhile, we are no nearer than we were seven years ago to the formation in London of a Senatus Academicus which shall retain in the metropolis—in contact with its statesmen, lawyers, retan in the metropolis—in contact with its statemen, lawyers, physicans, anknows, and the idealigest men and women of wealth physicans, and host physicans, and the physicans, and bologists. It is well that the Frendent of the Royal physician, and biologists. It is well that the Frendent of the Royal meetings of that body? that it senior Secretary abould speed with the physicans of the depth of the depth of the physicans of the onversities? The draft charter of the Athert of inversity does not even attempt to supply such a want. It actually makes the London professor more a creature of competition and the servant of red-tape officialism than he is at this moment. E. RAY LANKESCER.

MR THISELTON DYER has done good service in pointing out the nature of the proposed Albert University, which, unfortunately, seems not unlikely to be the result of the disunfortunately, seems not unlikely to be the result of the dis-cussions that have been going on for the last ax or eight-years with respect to a "Teaching University for London". Should the charter petitioned for by the Councids University and King's Colleges be granted, it will not constitute a reaching University in any real sense, but, as Mr. Tanelton Dyer says, an inattitution very similar to to hat the present University of London of course difficulties of the District Council Course of the Cour of course, differences of organization and machinery, such as the institution of Assemblies of Faculties and Boards of Studies institution of Asembles of Faculties and Boards of Studies (which the estating University ingigit institute next week, if it as difference of principle. The nervest approach to this are the provisions (1) that the Colleges whose institutes are to be eligible as catalidates for degrees shall have a certain amount of representations of the contract o supreat to the Queen in Council (instead of, as in the charter of 1837, being decided on directly by the Crown); (3) that "the University may appoint lecturers independently of a College or medical school to give instruction in any subject, whether it be or be not included in a Faculty."

With the exception of this last provision, slipped in at the end of Section V, "University Digress and Certifi dies," as though modestly shunning the notice that a separate heading might call to it, there is no allusion from beginning to end of the draft charter to any teaching to be done by or through the University as such If it comes into existence, it will be a mere examining University over again. Such a scheme can go no appreciable onversity over again. Such a scheme can go no appreciative way towards remedying the existing defects of University or ganization in London. It is not easy to see what public advantages are likely to result from it. Seeing that it is put forward as representing the views of University College, London, torward as representing the views of University College, London, it does not seem irrelevant to the present stage of the discussion to any that the scheme of the Albert University has never been submitted to a general meeting of the Governori of the College University College, London.

G CAREV FOSTER

The Draper Catalogue,

ON p. 133 of the current volume of Natures (June 11) Mr. Espin gives a comparison of the Drappe Catalogue of Stellar Spectra with the catalogues of Vogel and Dundr. Vol xxv of the Harward Amada, of which the first past will be distributed as the Catalogue of Mr. Spectra for the Stellar state of the Ste ON p 133 of the current volume of NATURE (June 11) Mr

type sters are always industinguishable from those of the second ways and the state of the state

The Cuckoo

I Do not know if the hibernating of swallows and other summer visitors is still a debated question or not, but the following account of a cuckoo may be of interest to some of vour readers

your readers

In the month of August a young cuckoo was taken from its nest and kepl in the house, where it lived and throve—until one day in November, when it escaped and could not be found. But in the following March, during the usual spring cleaning, this very bird was discovered on a shelf in the back kitchen, hidden very bird was discovered on a shelf in the back kitchen, nuagen away behind some old pots and pans, still alive, and salsep, with all its feathers off, and clothed only in down, the feathers bying in a heap round the body. The rude awakening which the cuckoo received was fatal to its existence, for it survived only for a few hours.

E. W. P.

Colour-Associations with Numerals, &c.

THE following record of experiments extending over a period of nearly ten years, under exceptionally good conditions, appears of nearly ten years, under exceptionally good condutions, appears to me to be worthy of attention. A preliminary note on the subject was printed in Science, vol. vi. No. 137, 1885, p. 242, part of which is reproduced below.

In 1880, while I was in Washington, I read Mr. F. Galton's note on "Visualized Numerals," in NATURE, vol. XXI p. 352

After I came to Wisconsin—probably late in 1881, or eatily in

After I came to Wisconsin—probably late in 1831, or early in 1832—I mentioned my own entire inability to visualize unnersia or anything else of the kind to a member of the University faculty, Prof Owen I was interested to learn that, when a boy, he had always conceived the vowel sounds as having colour, and that he still retained some traces of this early habit

that he still returned some traces of this early habit

I spoke of this subject in my house shortly after; and my
daughter Midred, then shout seven years old, and she she had
the still be subject to the subject I spoke of this subject in my house shortly after; and m

greenish

greenst. The prevalence of yellow and green, and the scarcity of reds and pinks, are noteworthy. I found that she knew these colours instastly, and when I asked for them in any order. What is more remarkable, she could instantly name the brown letters in a group, the black ones, &c. Apparently she did not require to pass the alphabet in review to decide this. The numbers also had dolours to her, as follows:

had colours to her, as follows:—
1, Mack; 2, cream colour; 3, light blue, 4, brown, 5, while;
6, crimson, pank; 7, greenish; 8, while, 9, greenish (1), 10,
brown; 11, Mack; 12, cream colour, 13, blue, 14, brown; 15,
while; that is, 11 had the same colour as 1, 12 as 2, 13 as 3, &c.
These colour were also named instantly, and in any order,

Case of Muss Mildred Holden.						
Age Year	= 7 1650	= 8 1883	August 1885	= 13 December 1887	3 14 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	= tó∳ June zāga
Monday	Blue	Blue	Blue	Bine	Blue	Blue
Tuesday	Pink	Pink	Pink	Pink	Pink	Pink
Wednesday .	Brown or grey	Brown or grey	Brown or grey	Brownish	Brownish	§ Brownish-grey-more
Thursday	Brown or grey	Brown or grey	Brown or grey	Brownish	Brownish	brown than grey
riday .	White	White	White	Whitisb	White	White
Saturday	Pure white	White	White	Cream : light yellow	Cream colour	Cream colour
unday .	Black	Black	Black	Black	Black	Black
A .			White	White	White	White
Ha.	_		Blue	Blue	Rine	Blue
C	_	_	Yellow; cream	Cream colour	Cream	Cream
D	_	_	Dark blue	Blue	Blue	Blue
		_	Red	Red	Red	Light red
7 1	- 1	_	Black	Brown	Brown	Brown
i	_	_	Green	Green	Green	Green
i ".		_	White	White	White	White
· '	-		Black	Black	Black	Black
	_	_	Grey; brown	Brown	Brown	Brown
	_	_	Grey Grey	Grey	Grey (?)	Grev
	= "		Dark blue	Blue	Blue	Blue
ii i	_		Brown	Brown	Brown	Brown
₹ .	_		Brown	Brown	Brown	Brown
, ,	_	_	Vellow	Cream colour	Cream (?)	Lream
6 1		_	Green	Green	Green	Green
			oreen ?	Purple	Purple	Purple
,	:	_	Brown	Brown	Brown	Brown
V .	_	_	Vellow	Vellow	Cream	Yellow
ř.	_	_	Green	Green	Green	Green
,		_	Vellow	Cream colour	Cream	Cream
		_	White	White	Citati	White, I think, not sur
· 1	_	=	Brown	Brown	Brown	Brown
	_	= 1		(Red	Red	Red
.		_ }	Not much colour	Cream colour	Cream	Cream
		/	Greenish	Green Colour	Green	Green
·	_ =	_	Black	Black	Black	Black
. i	= .	_		Cream	Cream	Cream
	_ :	_	Cream Light Blue	Blue	Blue	Blue
	= 1	_	Brown	Brown	Brown	Brown
	= 1	_	White	White	White	White
	_ :	_				
	_	_	Crimson; pink	Pinkish	Pink	Pink
:	- !	_	Greenish	Green	Green	Green
	-	_	White	Cream colour	White	Cream
		_	Greenish	Blue	Bluish-green?1	Dark blue

If anything

Brown

Brown

Mice—The column for face (\$\frac{1}{2}\$) was sent to mean a lateral varieties in the table, except that Wedersday and Thursday are described as "broomship gay, with lattle day," and Fridge," as "butto, with collecting the sout without giving much thought to the writing as fast as I can write. I am not quite definite in my mad as to the colours of \$\frac{1}{2}\$, 10, 6, T, X, O, Q, S, V, but the others have never changed. The days of the week I reser think of without thinking of the corresponding colours. They have always see manued the same. I don't quite remember if I have ever told you about the dois before, but they have always see there, and are the munite penul marks showing through the colour. Turnedy is slightly dotted."

before, out they have a lawsy nees mere, now are use unusuance person. The table gives the re-uils of the earlier experiments legeble: with others which have been subsequently obtained. The later experiments have been made under crucimatizes which are peculiarly favourable—usually by correspondence during my contract the state of the contract of the correspond to a gene colour, it appears, on the whole and in a general way, that the colour is associated with the sound rather than with the forw of a letter. Xee reample, are white, C, S, Stundey, are yallow, &c. There are numerous experiments of the contract of the work of the contract of the whole with the colour of the contract of the state of the contract of the state with the forward of the contract of the state of the contract of the contract of the state of the contract of arrive for definite conclusions to be drawn. Perhaps this brief note may induce others to print the results of similar investiga-EDWARD S. HOLDIN.

Mount Hamilton, June.

ío

Erratic Barometric Depression of May 23-29, and Hallstorm of May 24.

Black?

Black or brown

In connection with the very interesting letter of the Rev Clement Ley (on p. 150), descriptive of the barometric depression which passed over these isles towards the end of last month, the following extract from a letter of mine published in the local press, with a view of obtaining frither information, but without success, may be of interest. At the first information, but without success, may be of interest. At the first information, and at of the first information of the first information of great severity and lengthy duration, and at of p.m. the manufacture of great severity and lengthy duration, and at of p.m. the manufacture the ground and roofs of house were covered with a compact layer of frozen rain-drops, which at the end of half as manufact the ground and roofs of house were covered with a compact layer of frozen rain-drops, which at the end of half as the subject of the compact layer of frozen rain-drops, which at the end of half as the subject of the compact layer of frozen rain-drops, which at the end of half as the compact layer of frozen rain-drops, which at the end of half as the compact layer of the lattices, which were carefully all ovarious in form, were smaller than 0.1% by the organization of the period of the compact layer of the lattices, which were careful over use at it. I picked up a random at 6.10 p.p.a. when the terror was at its the following extract from a letter of mine published in the local

height, measured respectively 0 055 hy 0051 inch, 0437 by 0568 inch, and a spherical one had a diameter of 0 5 inch has a balloness ser, I believe, rately met with in storms of the control of the contr

"An Alphabet of Motions"

I HAVE lately found the following extract in Arthur Young's "Travels 1: France, in 1787," which I fancy is not generally known. It occurs in Betham Edwards's late edition (Bell and

Sons), at p. 96.

Sons), at p. 90.

"In the evening to Mons, Lomond. In electricity he has made a remarkable discovery You write two or three words on a paper; he takes it with him into a room and turns a machine inclosed in a cylindrical case, at the top of which is an electrometer, a small fine pith ball, a wire connects with a an electrometer, a small rine pith oall, a wire connects with a similar cylinder and electrometer in a distant apartment, and his wife, by remarking the corresponding monotons of the ball writes down the works they indicate, from which it appears he has formed an alphabet of motions. As the length of the wire makes no difference in the effect, a correspondence might be carried on at any distance."

J. S. DISMORR. Stewart House, Wrotham Road, Gravesend, June 24

On a Cycle in Weather Changes

It is known that Prof Brueckner, of Berne, in a work on "Klimaschwankungen," published a short time ago, offers a large amount of evidence for the view that our globe is subject to a weather-cycle of about 35 years, a series of cold and wet to a weather-cycle of about 35 years, a series of cold and wet years, or warm and dry ones, recurring at about that merval years, or warm of the control of the control of the control of the his essays (No lvm. "Of Vicissistide of Things"), makes refer to go which I have heard, and I would not have it given over, but wasted popen a little. They say it is observed in the Low but waited spon a nutle. Iney say it is observed in the Low Countries (I know not in what part) that every five and-thirty frosts, great wet, great droughts, warm winters, summers with little heat, and the like, and they call it the prime. It is a thing I do the rather mention, because, computing backwards, I have found the same concurrence." A B. M.

THE FORECAST OF THE INDIAN MONSOON

A FTER an interval of twelve more or less prosperous years, following on the memorable Madras famine of 1876-77, and the drought and fearful mortality of North-Western India in 1877-78, India seems once more to have entered on one of those prolonged series of adverse seasons which put a severe strain on the protective powers of its Government, and, despite all human precaution, bring suffering, disease, and premature death to thousands of its industrious peasants, and to even larger numbers of the impoverished outcasts who form the lowest fringe of its teeming population, fighting the precarious battle of their life at all times on the verge of destitution. The drought in Ganjam in the autumn of 1889 has been followed by the fallure of the late autumnal rains over the central districts of the Carnatic towards the close of last year, and the too familiar machinery of relief works for the able-bodied, and doles of food to the helpless indigent, has been in active operation for several months past in the districts around Madras Another monsoon, another season of those periodical rains on which depends the fate of millions, is now due and overdue, and there comes from India an ominous note of warning that there is reason to fear that more than one great province of the empire, or certain portions of them, may again this year he parched and barren, their young crops withering and shrivelled under the dry west wind,

while, month after month, men scan with ever-growing anxiety the pale dust-obscured sky and scattered ballshaped clouds that never mass themselves to rain-clouds. but mock their hopes with the promise of showers that

And this warning, alas ! is no mere guesswork of credulous and speculative minds, such as in these latitudes certain of our would-be weather prophets love to put forth at hazard, to furnish the topic of a day's gossip to the million, or haply to win for themselves a summer day's reputation with the uninstructed, in the event of a successful issue Certainty, indeed, there is not and cannot be till science shall have extended its domain far beyond its present limits; but, in India, the stately march of the seasons is but little obstructed by the vicissitudes of fugitive cyclones and anticyclones, that originate we know not how, and disappear by some concurrence of causes equally beyond our ken In the tropics, and in the realm of the monsoons, all weather phenomena are more massive and slower in progress, and each great change of seasons is heralded by signs which, if we can as yet but vaguely interpret them, are at least recogniz-able as such, and, with a certain allowance for possible error, must be accepted as timely monitors of what is likely to follow These it is that, whether rightly or wrongly deciphered, furnish the basis for the present warning. To those who, like the present writer, have warning. To those who, like the present writer, have followed for many months past, not without anxious in-terest, the telegraphic and other reports periodically transmitted from India, it comes as no surprise, but as a confirmation of misgiving, long entertained though only committation of missiving song entertaints thought only now backed by the warranty of full official evidence. The events of the next three months may yet belie the present indications, and that they may do so is still our fervent hope, but it would be folly to ignore them, and to shut our eyes to the probabilities that they seem to portend

For the last eight years it has been one of the duties of the Indian Meteorological Department, some time early in June, to prepare, for the information of Government and the public, a forecast of the probable character of the summer monsoon, based on the reports of the snowfall on the Himalaya and the western mountains, and on the indications afforded by the weather of the previous winter and spring. The possibility of framing such a forecast was in a measure foreseen by the Famine Commissioners appointed by the Home Government after the disastrous famines of 1876 and 1877, of which Commission General R Strackey, the true founder of the Meteorological Department of India, was the scientific member : and it is in no small degree due to the weighty advocacy of this Commission that the Department owes its present extension and importance Mr. Eliot's forecast for the coming season is now before us. It sets forth at length the general and special grounds on which he bases his conclusions; and these, though duly guarded by the reminder of their essentially empirical character, and of the unavoidable imperfection of our information regarding certain important data, are expressed in terms that leave unhappily no doubt of the adverse character of the out-

Attention was first directed to the apparent connection of the Himalayan snowfall with the prevalence of dry land winds in India, in the year 1877, and about the same time the late Prof. S. A. Hill and Mr. Douglas Archibald showed that, as a general rule, an unusual cold weather rainfall in Northern India was followed by a deficient rainfall in the ensuing summer monsoon. In a paper published in the Proceedings of the Royal Society in 1884, these two classes of facts were shown to be merely different phases of the same phenomenon, and a summary was given of all the evidence on the subject that had been accumulated up to that date. Since then, there has been but one year of heavy Himalayan snowfall, viz 1885, and in that year the rains were greatly delayed on the Bombay coast, and were very deficient in North-Western India in June, July, and September, commencing late, and terminating early. During the past winter and spring the snowfall on the North-Western Himalaya and the mountains of Afghanistan and Baluchistan has been excessive—indeed, as Mr. Eliot states, unprecedented during the last twenty-five years—and from the reports received from the civil officers and observatories in the received from the critical conservations in the mountain districts, he estimates that an average fall of 40 feet, if not considerably more, must have fallen over all the higher ranges, from Murree eastward to Garbwaj, if not to Central Nepal. That it was the same on the less accessible range of the Hindu Kush we have reason to believe from the casual reports that were received to believe from the casual reports that were received. during the last winter, and we know that in Southern Europe and even in Northern Africa, snow fell down to the sea-level, and was such as has hardly been experienced certainly during the greater part of the present century. The phenomenon has therefore been one of widespread incidence, and indicates some remarkable and rare condition of those higher strata of the atmosphere which, we have now reason to believe, are the seat of the more important changes that regulate the vicissi-tudes of the weather of the globe.

Concurrently with this exceptional extension of the snowfall to low latitudes of the temperate zone, the Indian registers afford evidence of certain abnormal features, which are such as have been noticed on former occasions of unusual snowfall on the North-West Himalava, and the bearing of which on the weakness of the summer monsoon is more clearly traceable In fact, they tend to link the two phenomena together, whether we regard them as the common effects of some more remote agency, or as displaying the different steps of a physical sequence of cause and effect. The most important of these are : the unusual rainfall over the whole of Northern India in the past winter and spring, amounting to from two to three times the average in the Punjab, where it was heavlest, a prevailing low temperature in Northern and especially North-Western India, together with a corresponding excess of temperature in Assam, Burma, and Southern India; and finally, a persistent excess of atmospheric pressure in the former region and a deficharacterized more or less all the months of the present year, especially March and May. As estimated by European standards, the anomalies of this last element may indeed appear small For instance, the mean excess at Peshawar in May was 0 052 inch, at Mooltan 0 041, and at Quetta 0'049 inch, while the deficiency at Calicut was 0'040 inch, and at Sibsagar 0 031 inch. Taken together, they constitute an anomalous gradient from northwest to south and east of something under a tenth of a barometric inch in distances of 1300 and 1500 miles. But in India such differences are relatively large, and, as former experience has abundantly shown, very significant As temporary phenomena they might indeed be of little importance; but, lasting as they have done through mearly half a year, they point to an anomalous state of the atmosphere which is evidently persistent, and is distinctly adverse to the northern incursion of the summer tinctly adverse to the northern incursion of the summer monsoon. Taking the general mean of all parts of the empire, the atmospheric pressure has been above the average in every month of the present year. With respect to the winds, Mr. Eliot remarks:—"South-easterly winds have been unusually prevalent in Bengal and Behar during the months of April and May, and north-westerly and northerly winds on the west coast of india as far south as Cochin. The unusual prevalence of north-westerly winds on the Bombay coast in the month of May was one of the features of the weather in 1876, 1883, and 1885, in which years the monsoon was greatly retarded on that coast."

NO. 1132, VOL. 44

Finally, after reviewing the chief characteristics of other years in which the Himalayan snowfall has been heavier than usual, Mr. Eliot draws the following conclusions with respect to the probable character of the monsoon rains of the present year in the different

provinces of India

"(1) Snowfall conditions on the Western Himalayas. &c., and the pressure conditions in India are very un-favourable to the establishment of a strong and early monsoon on the Bombay coast. It is very probable that it will not be established in full strength on the Bombay coast before the third or fourth week in June, and it is probable that it will be below its average strength, and may be withdrawn from Upper India earlier than usual

in September.

"(2) The snowfall conditions in the Eastern Himalayas. and the pressure conditions in North-Eastern India and Burma, are favourable to the advance of a moderately strong or strong monsoon in the Bay of Bengal earlier than usual, and to its establishment in Burma and Bengal before or about its normal period," and Burma, Bengal, and Assam are expected to receive an average or more than an average rainfall, Behar and the eastern districts of the North-West Provinces about the usual amount In Southern India it is shought probable that the rains may be retarded, but that Malabar and Southern India generally are likely to receive favourable rain during the monsoon.

On the other hand, it is pointed out that "conditions are very unfavourable for Raiputana, and also to some extent in Guzerat, the southern districts of the Puniah. and the western districts of the North-West Provinces. It is probable the rainfall will be more or less deficient over the whole of that area, and possible that the deficiency may be large and serious" In Northern Bombay and Berar it is thought that "the rainfall is more likely to be slightly deficient than up to its normal amount," and that in the Central Provinces it will be "fairly normal

From this abstract it will be seen that the region in which drought is chiefly to be anticipated is the western provinces of Northern India, comprising Raputana, Guze-rat, the southern districts of the Punjab, and the western districts of the North-West Provinces, provinces the average rainfall of which does not exceed between 20 and 30 inches, and which time after time have been the seat of disastrous famines. Now there is one consideration relevant to this subject of which no mention is made in Mr. Eliot's report, and which, notwithstanding that its bearing is purely empirical, cannot, we think, be entirely disregarded when dealing with the question of probabilities. This is the fact, first pointed out by the Famine Commissioners, that between 1782 and 1877, on no less than five occasions, a drought in Southern India was followed by a drought in Northern or rather North-Western India in the succeeding year. It does not seem possible, in the present state of our knowledge, even to suggest any physical explanation of this remarkable sequence, but it has been repeated too often to allow of our regarding it as purely fortuitous, and unfortunately it only tends to strengthen the probability of the adverse conditions inferred by Mr. Eliot from the existing state of things.

It must be confessed, then, that, according to our present means of judgment, the present outlook is by no means hopeful The mere fact of a retardation of the monsoon rains would not in itself afford cause for serious anxiety. According to the latest report from Madras, indeed, this part of Mr. Eliot's forecast seems to have been justified by the event, for on June 26 the Governor of Madras telegraphs that the south-west monsoon rains have not set in properly in the interior, and are very light even on the Malabar coast, whereas the date at which they are

We have taken the liberty of altering the punctuation of this telegram to bring it into accordance with sense and fact.

usually expected is the end of May or the beginning of June. The really critical months in North-Western India in Compense of the Compense o

PHYSICAL SCIENCE FOR ARTISTS!

11

WE next come to the absorption of light 1 do not know whether you have had any opportunity yet in your laboratory course of observing the spectral pheno-mena produced when white light, or say solar light, is absorbed by different substances

The white light is broken up by the dispersion of the prisms into a rain-bow band; while it is possible, by one means or another, one substance or another, to filch out of this coloured hand some of the constituent colours, now at one end. now at another, sometimes in different parts at once; and when this has been done, the light which finally reaches when this has been done, the ught which man, the eye may be of any colour, as is evidenced by the different colours you see in a stained glass window is what happens also by the absorption of our atmosphere, due in all probability in great part to the contained aqueous vapour The sun is white in the middle of the day and red at sunset The blue part of the light, which, when all the colours reach us, looks white, has been taken away, and practically nothing but red is left; only certain parts of the spectrum are left. It is easy, after two or three hours' experiments with the absorption of light by different inedia, to grasp the laws which govern sunset colours precisely as it is easy in the anatomical school to study the facts relating to the human form, particular muscles and the like A diligent student will thus have the world of colour at his feet. This can, however, only be done by one interested in physical science, and I think it should be done by anyone who wishes to deal with landscapes or seascapes, anything, in fact, which has to do with the natural world. The results obtained in this way of course come to us pictorially, chiefly in the colour of sky and water and in the colours of clouds, and they are mixed up in pictures by the knowledge, or want of knowledge, of the artist who paints these various reflecting surfaces. The reflecting surface, whether water or cloud, or what not, mist not only be true in colour, but perfectly formed, in order to give an absolutely perfect and pleasant picture.

Here I think it is that the need of physical scenee is greatest, and I do not know, in fact, that there ought not to be some kind of an examination in a College like this which shall insure that anjone who in going to take up the study of art is not colour-blind. This is done in the case of sations and eignine-drivers, and I think it should be done in the case of artists. There are pictures which have apparently been painted by colour blind people; and much skill has been wasted in consequence of such a much skill has been wasted in consequence of such a malformation as this.

It may be, of course, that in some cases, where the thing may be charttably supposed to arise from a physical defect, it is the result of mere ignorance, or want of observing power; but if that be so, then my point is proved, because it is clear that a good scientific training will cause all the proving the control of the proving the course of the proving the course of the proving the course of the proving the

NO. 1132, VOL. 447

rewarded by the exquisite truth of some of them, that one could very well look over the defects of others, if all thoughts of the possible progress of art achievement

were hanished from one's mind. Some of you may perhaps have read Mr. Ruskin's lapter on clouds The scientific basis of the various chapter on clouds cloud forms, however, you will not find there Now when we consider that in land- and sea-scapes the sky, and especially the clouds, are among the most important re-flectors of light, whether white or coloured, the form of the cloud is absolutely of very high importance If the light is reflected by an absolutely impossible cloud, your delight at the colour, which may be true, is absolutely checked by the treatment of the anatomy of the cloud Here, again, we touch a distinct branch of physical science An acquaintance with the various forms of condensation assumed by aqueous vapour under the various conditions of the atmosphere would certainly keep one right where one would be very apt to go wrong I referred, also, to the reflection of sunlight, whether white or coloured by absorption, by water. Here, I think, is a region where physical science is also helpful There can be no question that the grandest display of colour in the natural world is a sunrise or sunset, either at sea, or where there is a water surface to bring in a second series of re-flection phenomena. As a rule, perhaps, if the water be somewhat land-locked, or at all events not broken up by strong wind, the effect is finer, and this perhaps is one of the reasons, but only one, why the sunsets seen off the west coast of Scotland are so remarkable

This, however, does not always hold 1 have seen a sunne in the Mediterranean when passing the Strats of Gibialiar twenty years ago, which was so magnificent, that not only is it still present in my mind's eye, but all the sulfors who were swabbing the deck at the time ceased work and simply gazed at it entranced. It promised to be a cloudy sunrise, but suddenly the cloud pall melted not mackerel sky, and the sun at rising payed out different colours on the high and low patches, the sea was choppy, and every facet of every wave, and every facet of a facet, being turned to different parts of the sky; these pucked up and reflected to the eye different colours, so

here deep wave looked like a casket of genta.

Ihe red or yellow colours on the clouds depend simply upon the thickness of the atmosphere which the sunlight has traversed for reach them; the colour depends absolutely upon the light received from the sun, and it has nothing to do with the apparent angular distance from the sun in your picture, but while all this change is going on in the clouds the sky itself will be somed above the horizon from the red to the blue overhead, and in addition to that, you will get the gruster humbowy nearest addition to that, you will get the gruster humbowy nearest the control of the colours of th

I have noted a few of those pictures this year, which, in my opinion, and I only give it for what it is worth, are remarkable for their truth, or for the absence of it, in different degrees. The numbers are those of the Royal Academy Catalogue, unless otherwise stated —

Clouds.—Good colour, 311.

Good form, 288, 600.

Good colour and form, 238.

Water.—Good colour, 520, 1029

Good colour, 520, 1029

Good colour, 520, 1039.

New Gallery, 102,

With great deference I must, until convinced to the contrary, hold that much of the colour in the following

pictures is impossible—\$43,1028, 176, 192, 515, it is bad in 203, 498, 586, 602, 1044, 1071.
The cloud forms in 498, 556, and 966 are unlike any-thing I have seen in any quarter of the world.
But cloud is not the only thing we have to deal with.

There is a still finer form of aqueous vapour which shows itself as atmosphere, its function is to soften distant outlines, to gradually assimilate colours, laying, so to speak, its own upon them, and then, again, to soften even this So that distant vistas of hills and vales first become blue in revailing tone, but the most distant ones lose this, and fade to a more neutral tint.

These things this year are admirably rendered in 1130 293 offends by the impossible hardness of the hill on the

right of the picture.

To most of you the terms selective absorption and selective reflection of colour are familiar; of the latter an admirable study is to be found in 1062. For reflection badly managed, study 145 in the New Gallery. The artist seems to be under the impression that some birds have a special capacity for reflecting colour.

Of special studies of various natural objects, I think the following in the German Exhibition are worth examination. a glacier (287), cloudy moonlight (433); careful study of light-grading (but sun should be more

luminous in the latter) (52, 343)

It is not a little singular that we should find such a close association between bad cloud forms and bad colour It was a true instinct which led Mr Ruskin to treat of these matters in his "Mo lern Painters," but why did he not go further into the real basis - the real grit of it all, instead of confining himself to the mere fringe of these great subjects? It was, I expect, because the possible connection between science and art was less recognized then even than it is now. But is it too late? No one could touch the questions still with more sympathy than Mr Ruskin

But to come back to the pictures Almost, if not quite as good as 600, is No 50 in the German Exhibition find in 630 a careful study of colour The most wonderful colour which can be got on nearly still water is that you sometimes see at sunrise or sunset with a good green or yellowish sky near the horizon, and a perfectly blue sky overhead in that case every unit of the surface (every undulation) will reflect to your eye a certain amount of horizon-light and a certain amount of blue sky, and the total result will be a sea of molten steel Another point in this connection se a sea of morten seed a miner point in the connection of this kind from several surfaces besides water. I was in Egypt last winter, and I saw a wonderful sunset, looking out from the little quay at Ismailia. The sand of the

desert lay beyond and round the water in the fore-ground, which was more or less bluish; the lake, in fact, is bounded by sandbanks of no great elevation, the canal coming in at one end and running out at the other In the day-time in full sunshine the sand is yellow, as

vellow as it can be, and at sonset it is grey-white There is nothing very remarkable in the sky, but the intense blue in the sky overhead. There is no aqueous vapour to absorb, and therefore there is no colour But wait for the afterglow! when you get sunlight, reflected from the clouds or sky, which reaches your eye after two transmissions through the lower air ; then you can get colour, and you do get it What you see is the most exquisite violet halo, and the colours with which we are familiar here more or less , but the striking thing is the intense violet halo in the sky, and the warming up of colour till the sunset place is reached. Well, now, what is the effect of that upon the landscape? Everything is turned green, for the simple reason that the only constituent common to the colour which reaches, and is reflected most readily by, the sand, is the tint of green the sands change, as if by magic, into a wonderful chlorophyll green. Now, I venture to think that the artist who endeavours to work out problems of

this kind will be more likely to paint a beautiful picture than the one who copies nature merely, and this brings me into strict harmony with the Academy motto. It seems to me that physical science may in this way, if associated with the study of art, give us new possibilities in the art future that will transcend anything that we know of now, and the time will certainly come, ultimately, when the highest art will result from the study of natural science and the science of the human form.

Seeing that already artists spend years in the study of only one part of the field of observation, they must surely

annex other branches

It would not be right if I concluded what I have to say without calling attention to the important remarks made by Mr Briton Rivière, on science in relation to painting, at the Edinburgh Art Congress

"Whatever may have been done in other lines of human energy during the Victorian age, there can be no question that its most remarkable achievements, both theoretical and practical, have been those of science. The art of the painter has not escaped its influence. one side, and a very important one-that of realism-the side which furnishes the language-re the signs and symbols which express the idea of the artist—there is a wide front open to the influence of science, and on that side art has not been slow or unwilling to follow the advice of science, or ungrateful for the valuable help it has afforded. According to my theory, this supremacy of science would have influenced art under any circumstances, but it has been able to do so through the very method and language of art itself

"Will this influence help or relard the influence of art? My answer is, it may do either, according to the manner in which it is received and used by the artist. If the painter resolutely holds the belief that painting is a language, and a work of art the expression of an idea, and uses science, and all that it has discovered and teaches, to enable him better to understand his signs and symbols, viz the material facts of nature, so that by means of them he may express himself correctly, just as a writer has behind him the philologist to busy himself about the derivation and meaning of words, and the grammarian to show him how to place these words so as to produce the meaning he requires—if, I say, the painter so receives and uses the knowledge and appliances of science, then I think the cause of art will be much advanced by science, and works produced under its influence will be stronger and richer than they could possibly have been without it. On the other hand, if the painter allows this scientific knowledge of the material or realistic part of his work to obscure the purely artistic or ideal part of it, to obscure instead of to intensify the tdea, and if, carried away by the material wonders of the 'thing' which science has unfolded, he forgets the 'thought' altogether, then assuredly, however true he may have shown himself to be to the cause of science, that of art will suffer at his hands-indeed, may be lost altogether For I feel sure that most of my brother artists will agree with me that it is possible for a picture to be scientifically true and have no art at all in it, and, on the other hand, to contain several scientific blunders and yet be a great work of art."

It will be seen, then, that I have ventured to-day to

re will be seen, inche, that I nave ventured to out you preach no new doctrine to you; even my gloss on the Academy motto is endorsed by Mr. Briton Rivière. But I Can go further than this, and quote Prof. Helmboltz in support of the gloss. You should all read his admirable lecture "On the Relation of Optics to Painting". In it he remarks, "The artist cannot transcribe. Nature he must translate her;" and he adds, translation may give us an impression, in the highest " Popular Scientific Lectures," Helmholtz, and Series, p. 135. (Long-mans 1881)

degree distinct and forcible, not merely of the objects themselves, but even of the greatly altered intensities of light under which we view them. . . Thus the imitation of Nature in the picture is at the same time an ennobling of the impression on the senses."

Let me congratulate you on the fact that here, at all events, the importance of physical science in its relation to art is not forgotten. | NORMAN LOCKYER

LUMINOUS CLOUDS

I N an article contributed to NATURE on November 20, 1800 (vol. xltu p. 59), Herr O Jesse (of the Royal Observatory of Berlin) gave an account of the observations of luminous clouds He has retently submitted to the Prussian Royal Academy of Strences a record of later work; and, as the subject is one of considerable interest, it may be worth while to translate his pure?

With regard to the results, already bnefly noted, obtained in the summer of 1890. I have now to ieport more precisely, that with the help of the grint made by the Academy of Sciences we were able, during the period when the phenomenon appeared, to secure a collection of photographs which afford rich material for study

On this as on previous occusions the clouds were visible only between the end of May and the beginning of August They appeared for the first time in 1890, on May 26, for the last time -and then there was only a feeble trace of them—at the beginning of August I he phenomenon, therefore, was seen within nearly four weeks of the summer solstice—before and after it—but cheful after it.

Since my last seport, I have received confirmation of the statement that the time when the plannamenon appears in the southern hemisphere has a corresponding relation to the summer solstice there. Unfortunately, however, more precise facts with regard to place, Sc., in the southern hemisphere, are still lacking.

and sometime the superior of the control of the con

The phenomenon was again less bright than it had been in the preceding year (Tilly when the atmosphere was exceptionally transparent was there an approach to the former brillador. The aggregations of these masses of particles are obviously becoming thinner, as may also be perceived from the more distinct appearance of certain relations of structure, like the ridge and rib formations (wave formations) mentioned in my last report. Formerly these were concealed by superposition goas strata; now the characteristic these of the configurations consisting of these ridge and rib formations present themselves more simply and in greater isolituous.

It has now been proved more successfully than before that the ridges or longitudinal strips lie parallel to, while the ribs or cross strips are almost at right angles to, the direction of the movement of the entire cloud Further, we made on different days several series of measurements

NO. 1132, VOL. 44]

of the distances of the ribs (wave-crests) from one another with the following groups of results:--

Mean	value	of the	distances	of g	wave-crests	Kilom 83
	"	**	.,	10	**	99
	"	,,	**	10	**	8'4
					Average	8 9

1.specially striking, last summer, was the difference between the clearness with which the clouds appeared in the morning hours, and that with which they appeared at the corresponding times before midnight

With regard to the height of the luminous clouds in the summer of 1850 the measurements, so far as they were definitely calculated, gave the mean value of 82 kilom, agreeing almost exactly with the value of nearly 83 kilom, deduced from my photographs of 1880

The persistence from year to year—now for the first time shown with sufficient accuracy—of the distance and therefore of the position of the level surface of the phenomenon, would alone deserve to be recorded as a scientific fact of great importance

Is for the speed and directions of the movements, it was again found that the chief component of the movement was directed from east to west, and amounted to neurity too metres in the second, while the speed of the revolution of the zone of the earth above which the doubt were placed is about 240 metres in the second from west to east

The e was also a smaller and variable component in the direction of the meridian. This was directed from north to south at the times at which we have litherto obtained tolerably secure determinations of movement.

The points of view from which the phenomenon of luminous clouds, on the ground of the observations hitherto made, is to be regarded, are already numerous. There is still, however, a wide field for research in connection with the questions, What are the forces which make the phenomenon appear chiefly in the morning hours? and. What is the nature of those forces which cause the movement of the clouds to be mainly from the north-eist, and drive them from the northern to the southern hemisphere and back again? Then the question as to the lieight of the phenomenon in different latitudes is probably of great importance for the constitution of our atmosphere, and not less interesting is the question relating to the material of which the luminous clouds are composed Unfortunately the interest taken by the scientific world in this remarkable phenomenon is in general so small that during the short time the phenomenon will probably present itself we can scarcely expect to obtain for these questions answers that shall be to any considerable extent satisfactory

WILHELM EDUARD WEBER.

THE venerable physicist, Wilhelm Eduard Weber, whose death on June 23 we shortly announced last seed, was born at Wurtenberg on Copiese 4, and the seed of Posture Divinity at Wittenberg 2. He studied at the University of Halle, where Schwegger was then Professor of Physics, he took his Doctor's degree in 1826, became Provationent in the following year, and Professor-Extraordinary of Physics in 1828. In 1831 he was called to Göttingen to succeed Joinan Tobias Mayer in the Char of Physics, and remained there util 1837. Among other results of the death in this year of King William Lot Charles of Physics, and remained there util 1837. Among other results of the death in this year of King William Lot Charles of Physics, and remained there util 1837. Among other results of the death in this year of King William Lot Charles of Physics, and remained there util 1837. Among other results of the death of this year of King William Lot Charles of Physics, and remained there are the seed of the seed o

[&]quot;Sitzungeber.chte der König'ich Proustischen Akademie der Wisse schaften zu Berlin," 1891. xxvi Si zung der physikalisch-nanhematische Classe, vom så Mar Untersichungen über die sogenannten leuch ende Wolken," von O Jasse, Steglitz.

powers of hereditary rulers. In his view the narrow liberties enjoyed by his subjects, under the Constitution reluctantly granted by William IV. in 1833, were excessive and intolerable. He suspended the Constitution, and thereby called forth vigorous protests from Dahlmann and other Pro-fessors of the Hanoverian University As a punishment, seven of them—Dahlmann, Weber, the two Grimms (Jacob and Wilhelm), Albrecht, Gervinus, and Ewald-were ejected from their chairs, and Gervinus. Dahlmann, and Jacob Grimm were even expelled from the country From this time Weber lived for some years in retirement, but in 1843 he accepted the Professorship of Physics in Leipzig (in succession to Fechner), and in 1849 he returned to his former position in the University of Gottingen He was in Gottingen at the time of his death

Wilhelm Weber's eldest brother, Ernst Heinrich, was the celebrated Professor of Anatomy and Physiology at Leppag He was born at Wittenberg in 1795, and died at Letpag in 1878, having been elected a Foreign Member of the Royal Society of London in 1862. The youngest of the three brothers, Eduard Friedrich, was also highly distinguished as an anatomist, and held office for many

years in the University of Leipzig
Weber's first contribution to science at once took rank weepers arist continuition to science at once took rank as a scientific classic, a position it is likely to keep for many years to come This was "Die Wellenlehre auf Experimente gegrundet." a volume of 574 pages, and 18 copper plates, nearly all engraved by the authors, published in 1835 by the brothers Ernst and Wilhelm Weber, and embodying the results of numberless original experiments and observations One of the most striking results of these investigations was the discovery that, when a regular series of waves follow each other along the surface of water, the particles at the surface describe vertical circles whose plane is parallel to the direction of propagation of the waves, and those lower down ellipses of which the vertical axis becomes smaller and smaller with increasing depth. As to the composition of this work, the authors say that it grew up as the result of such constant and intimate communication between them with regard to all parts, that it is impossible to assign to either of them the separate authorship of any distinct portions.

For several years Weber continued to occupy himself mainly with questions of acoustics, on which he published various papers of importance. In 1833 he published, in conjunction with his brother, Eduard Friedrich, a me-morable investigation into the mechanism of walking

"Mechanik der menschlichen Gehwerkzeuge") "Mechanik der menschichen Gehwerkzeuge")
But it is chiefly by his magnetic and electrical researches that Weber's place in the history of science is
marked These are contained for the most part in the
"Resultate aus den Beobachtungen des magnetischen
Vereins," published by Gauss and Weber from 1837 to
1843, and in Weber's "Elektrodynamische Maassbestummungen" (published in collected form in 1864, though the first paper dates from 1846) In this series of papers
Weber showed for the first time how methods of absolute measurement, analogous to those which Gauss had very shortly before shown to be applicable to magnetic measurements, could be extended into the region of electricity. Before this time Ampère's splendid discoveries as to the laws of the mutual forces between magnets and conductors traversed by electric currents, or between two such conductors, had been made known, and G. S. Ohm had established once for all the relations between electrical resistance, electromotive force, and strength of current; but, nevertheless, there was as yet no settled system for the measurement and statement of electrical quantities themselves. Until Weber's time electrical measurements were merely comparisons be-tween magnitudes of the same kind the resistance of one conductor could be compared with that of a par-ticular piece of wire, the electromotive force of one

battery could be compared with that of another; but that the value of an electrical quantity could be stated without reference to any quantity of the same kind, and in terms not involving any physical constants but the units of length, time, and mass, was as yet an entirely new conception. Weber, however, not only showed that such a system of measurements was theoretically possible, but in a series of most masterly experimental investigations he showed how it could be practically carried out. Our countryman Sir William Thomson was one of the very first men of science to recognize the fundamental character and farreaching importance of Weber's work, and owing mainly to his clear-sighted advocacy of the absolute system of measurement, this system was from the first adopted as the basis for the operations of the British Association Committee on Electrical Standards, appointed originally in 1862. This system has now become so familiar to electricians, and is taken so much as a matter of course, that it requires some mental effort to recall the state of science when it did not exist, and to appreciate the intellectual greatness of the man to whom it is due If we consider method and point of view, rather than acquired results, it is not too much to say that the idea of absolute measurements, underlying as it does the conception of the conservation of energy, constitutes the most characteristic difference between modern physics and the physics of the early part of our century. And to no one man is so large a share in this great step due as to Wilhelm Eduard Weber.

Weber was a Corresponding Member of the Institute of France He was elected a Foreign Member of the G. C. F.

Royal Society in 1850

A SOUVENIR OF FARADAY

THE following letter, written by an old friend of Faraday's and of mine, long since dead, may raraday's and of nune, long since dead, may interest your readers, now that we are celebrating the centenary of Faraday's birth. It came in reply to one in which I asked Mr Ward's assistance in preparing an obstuary notice of Faraday for the Chemical News. WILLIAM CROOKES.

Cornwall, August 30, 1867

DEAR CROOKES,—I should be proud indeed to be the spokesman of the chemical world in doing honour to Faraday's illustrious name on the occasion of his accession. sion to immortality

But I should not dare to meddle with the laurels on so august a brow, without many days and nights of earnest research and meditation, to fit me for summing up, with-out omission, the splendid list of his imperishable labours

Only in this reverential spirit of earnest solicitude to do aright, which is, if I mistake not, the philosophical counterpart of prayer—of the religious feeling—could so solemn a duty be fitly undertaken.

Only with the aid of other minds, kindred with Fara-day's in genius, and filled with the light of his manifold discoveries, could any one man's mind become an adequate mirror to reflect the gigantic Shadow that has just passed to its place in futurity.

For the present it is my fate to fulfil much humbler duties—which, having undertaken, I have no right to set aside For duty must still be done, even when such appeals as yours set the wings of the caged lark trembling, and point him upwards to his barred out home.

I must remain, therefore, a unit among the millions

whose hearts do silent homage to the illustrious dead; and can but watch from afar the starry coronation of which you invite me to be minister.

So best, perhaps. For, after all, the name and fame of

Faraday transcend all pomp of celebration, all burning words of praise. For whose the pen to weave so bright a glory as that electric fire which glows, through all the ages, round his brow, who first drew lightning from the lodestone, as Franklin drew it from the sky?

In the moment of separation that little spark breaks forth—instantaneous yet eternal. It is but one vivid point of the radiance that eneurcles his name, yet of itself it is glory enough.

From that spark a new branch of science has sprung, and under its creator's name, were it mine to carve his

epitaph, these three should be the chosen words :-

FULMEN ERIPUIT FERRO Ever yours faithfully.

F. O. WARD.

NOTES

WE print elsewhere an account of the fourth annual meeting of the National Association for the Promotion of Technical and Secondary Education. After the meeting an important conference was held, and it is now hoped that all the influences which are tending towards the establishment of a proper system of technical instruction in England may soon be thoroughly organized. Next week we shall have something to sav about the work of the conference and about the Association's report

THE conversatione given by the President of the Institution of Electrical Engineers, Prof. Crookes, F.R S and Mrs Crookes, on Monday evening, was brilliantly successful. It was held in the gallertes of the Royal Institute of Painters in Water Colours, Piccadelly. There were about 800 guests, among whom were many eminent men of science

On Tuesday evening the Fellows of the Royal Meteorological Society and their friends dined together at the Holborn Restaurant, to celebrate the entrance of the Society upon its new premises in Great George Street, Westminster Mr B Latham, the President, occupied the chair. Mr A. R. Binnie (Engineer to the I ondon County Council) proposed "The Royal Meteorological Society," and Mr G. J. Symons responded Mr. Latham, replying to the toast of "The President," referred to the enormous amount of records in the possession of the Society. All they now wanted was a few more members However, they had gone on increasing, and were now in a prosperous state, as they had been able to collect from the members of the Society a considerable sum of money, which had been funded, and the interest on which would meet the expenses of the new establishment. The Society now possessed one of the finest meteorological libraries in the world, and one which would be of enormous value to future generations.

WE are glad to note that the Marine Biological Association have now only three unoccupled tables. Many investigators are taking advantage of the facilities offered them at Plymouth

THE Exhibition Committee of the Photographic Society of Great Britain announce that the augual exhibition of that Society will be held at the Gallery of the Royal Society of Painters in Water Colours, Pall Mall East, from Monday, September 28, until Thursday, November 12 next The exhibition will be open daily (Sundays excepted) from 10 a m. to 5 p.m., and on Monday, Wednesday, Thursday, and Saturday evenings from 7 p.m. to 10 pm. Medals will be awarded for artistic, scientific, and technical excellence of photographs, for lantern transparencies, and for apparatus.

THE Pacific Postal Telegraph Company had lately a gathering of some 500 guests at the opening of a new telegraph office

NO. 1132, VOL. 447

in San Francisco. After shortly describing the various instruments, Mr. Storrer, the superintendent, said he was often asked how long it took to telegraph to different places and get a reply He would therefore now send a telegram to Portland, New York, Washington, Scattle, Tacoma, Canso (Nova Scotia), and London, inquiring about the weather The first reply came from Portland in 3 minutes, " Weather fine", the next from New York in 3 minutes to seconds, "Misty and warm" Washington in 3 minutes 11 seconds, "Misty and warm" Seattle in 2 minutes 21 seconds, "Misty and calm", Tacoma in 3 minutes 28 seconds, "Misty, cool, and calm", Canso, Nova Scotia, in 4 minutes 20 seconds, "Cold and misty" while the answer "Misty and cold" came from London in 6 minutes 22 seconds.

THE Governors of the Royal Holloway College have appointed Miss M. W. Robertson to the Resident Lectureship in, Natural Science Miss Robertson, who is now a lecturer on the staff of Alexandra College, Dublin, has taken the degrees o B A and M A, with high honours in chemistry and physics. at the Royal University of Ireland, and has also gained the University Studentship in Experimental Science

THE Education Department has issued a memorandum, by Mr I G Fitch, on the working of the free school system in America, France, and Belgium

Till death of M Rodolphe Kooppelin, a distinguished chemist, is announced. He was born at Colmar in 1810, and from 1828 to 1850 held the Chair of Physics and Natural History at the College of his native town For many years he was intimately connected with the Agricultural Society of the Upper Rhine, and, as a chemist, he was able to render great services to the agriculturists of his department After the Franco-German war, M Koppelin quitted Alsace, and settled in Paris, where he was regarded as one of the most eminent members of the Alsatian colony

In another part of the paper we print a report, by Herr O Jesse, of his observations of luminous clouds in the summer of 1800 We learn from Herr lesse that on the night of June 25-26 last the luminous clouds were again very visible at Sterlitz and Nauen, and that they were photographed eight times simultaneously at these two places. Writing to us from Sunderland on July 1, Mr 1 W Backhouse says there was a fine display of the luminous clouds during the previous night, their motion being, " as usual, from a north-easterly direction Mr I) I. Rowan informs us that on the same night, from 11.30 p m. to 12 30 a m, the clouds, as seen at Kingstown, co. Dublin, "appeared well-developed on a polar arc of 30" and at a mean altitude of 5° " They had been faintly visible at Kings town on June 3, 7, and 9 It is astonishing that no observer seems yet to have had energy and intelligence coough to take spectroscopic photographs of these striking phenomena

ACCORDING to a telegram from Melbourne, dated July 4, the Swedish-Australian Antarctic Committee of the Victorian branch of the Royal Geographical Society, which was formed to raise subscriptions in order to take advantage of Baron Nordenskiold's offer to equip an expedition to the Antarctic regions, announces that a sum of £3000 only is required to complete arrangements, and that there is every prospect of the expedition starting in about fifteen months' time. It is expected that the expedition, in addition to its geographical and other scientific discoveries, will be the means of opening up extensive whale and other fisheries in the Antarctic seas.

WE learn from the Botanical Gasette that Lieut. R E Peary, of the U.S. Navy, proposes to reach the North Pole on foot through Greenland, starting from Whale Sound, and expecting to be absent from It to st years. He states that the region about Whale Sound is rich in Arctic plants. Kane having brought over 106 species of Phanerogams and 42 of Cryptogams, several of which were new, but that very little has been done in its investigation since that time.

THE danger of using argenical preparations for the poisoning of plants is illustrated by the fact that Dr. B. L. Robinson, assistant in the Gray Herbarlum, Cambridge, U.S.A., has been compelled to resign his position owing to ill-health resulting from this cause. It is stated that the poisoning of plants has now been entirely abandoned in the herbarium; the tightness of the cases, and constant handling of the sheets being relied on to preserve the specimens

MR. SPENSER LE MARCHANT MOORE has been appointed botanist to the Matto Grosso Gold and Explorations Concessions Expedition, which is about to depart for Brazil

A NEW botanical journal has just been started, devoted to the diseases of plants, Zeitschrift für Pflanzenkrankheiten. edited by Dr. Sorauer, and published at Stuttgart

DR JOHN MURRAY contributes to the Journal of Botany for July a very interesting account of the Clyde sea area, its physical characters, and the chief features of its natural history This sea-area is a natural system of deep-sea basins or lochs in the west of Scotland, communicating southward with the Irish Channel by a single opening between the Mull of Cantyre and the shores of Wigtown and Ayr It has a water surface of about 12,000 square miles, its greatest depth is 107, and its mean depth about 29 faihoms There is a great variety in the pelagic fauna and flora in the surface and intermediate layers of water, the abundance and the species of organisms varying in the different layers according to the seasons, and even in different years. There is likewise a great variety in the bottomliving fauna and flors, which varies according to the nature and depth of the bottom in the different parts of the area. In some of the deeper lochs a few animals are met with which do not usually occur in more open situations around our coasts till a depth of 200 or 300 fathoms is reached. Some of these forms are limited to one loch on the west coast, for instance, Concharesa elegans, which is abundant in Loch Etive This form has never been taken in any of the lochs of the Clyde sea-area, although Euchata norvegua, with which it is associated in Loch Elive, occurs abundantly in Upper Loch Fyne and Loch Goil Nyctiphanes northerica and Borcophanica Raschie, which are abundant in the upper locks of the Clyde sea area, do not, on the other hand, occur in Loch Elive

THE French Minister of Public Works has addressed a circular letter to eivil engineers, asking them to use their influence to protect prelustoric monuments from the injury often done by ignorant proprietors. It seems that little respect is shown for such monuments in some parts of France La Nature speaks of a proprietor who sold "a magnificent doimen," which was to be transformed into "a tomb in a cemetery"

In his report, for 1890, to the trustees of the Peabody Museum of American Archeology and Ethnology, Prof. F. W. Putnam, the Curator, records that in no former year had the friends of the Institution been so generous in giving aid Gifts for current expenses were received which, in the sum total, exceeded the regular income from the funds, and Mrs Mary Copley Thaw, of Pittsburg, added no less than 30,000 dollars to the amount held in trust, this sum being set apart as an endowment for a fellowship.

An apparatus has been recently constructed by M Ducretet, NO. 1132, VOL. 44]

80° C. below zero, by means of the expansion of liquid carbonic acid. The inner of two concentric vessels contains, in alcohol, a serpentine metallic tube communicating through a tube with two stopcocks, with the carbonic acid reservoir outside, and opening below into the annular space round the inner vessel, in which are some pieces of sponge impregnated with alcohol-This two-walled vessel with coil is inclosed in a box. One stopcock being opened wide, the other slightly, the carbonic acid passes through the coil as snow, and turns to gas, with strong cooling effect, and sny of it not vaporized in the coll is dissolved in the alcohol of the sponge. The gas escapes through a tube passing through the outer box. The instrument, called a cryogen, is represented in Cosmos of June 27.

EXPERIMENTS have lately been made by Herr Regel (Bot. Centralb.) with reference to the influence of external factors on the smell of plants. In the front rank appears the direct and indirect influence of light on the formation of etheric oils and their evaporation. In the case of strongly fragrant flowers (as Reseda) heat and light intensify the fragrance, which in darkness is lessened without quite disappearing. When the whole plant was darkened, those huds only which were before pretty well developed yielded fragrant flowers; the others were scentlets If, however, only the flowers were darkened, all were fragrant. Other plants open their flowers and smell only by night (as Nicotiana longiflora and Nyclerinia copensis) When these plants were kept continuously in the dark, they, in course of time, lost their scent, as they lost their starch. On being brought into light again, both starch and fragrance returned, Besides light, respiration has a decided influence on the Nycterinia, inclosed in a bell iar with oxygen, behaved normally, but with hydrogen the flowers did not open, and had no fragrance. In general, the opening of flowers coincides with their fragrance, but there is no necessary connection between these phenomena

A NEW antiseptic, said to have certain advantages over those hitherto in use, has been brought before the French Academy of Medicine by Prof Berlioz, of Grenoble, extreme solubility, harmlessness, efficacy, and rapidity of action are claimed for it. It is called microcidine, and is a compound of naphtol and sods, is neither poisonous nor irritant, is twenty times as active aborse acid, and much more soluble than thymol, carbolic acid, &c Microcidine has the form of a greyish-white powder a solution of 3 grammes per litre it is very slightly coloured, but it does not stain either the hands or bandages For family use it is said to be of great service

MOST Russian geologists are now of opinion that the boulderclay which covers the whole of Middle Russia is nothing but the bottom moraine of the ice-cap which, during the Glacial epoch, extended from Scandinavia and Finland to the latitude of Kieft and Poltava A couple of years ago, Prof. Pavloff, while working in connection with the Geological Survey in Nijni Novgorod, indicated some traces of an inter-glacial milder period among the glacial deposits covering the province. Like indications have been noticed in Poltava and Tchernigoff New data to confirm this view are now given by N. Krischtasovitch in the Bulleten of the Moscow Naturalists (1890, No 4). After a careful exploration of the Quaternary deposits at Troitzkoye---a village on the Moskva River, seven miles to the west of Moscow, the diluvial deposits of which have very often been mentioned since Prof. Rouillier's and Murchison's times-the Russian geologist came to the conclusion that these deposits are indicative of an inter glacial period, during which Middle Russia had a flora and fauna much like those which exist now, but with the addition of the Mammoth The layers described by M. Kraschtafovitch as inter-glacial are of lacustrane origin; they for getting quickly in the laboratory a fall of temperature 70° to are covered with undoubtedly glacial deposits, and they are

deposited over glacial sands containing boulders of northern origin. Further research, however, is wanted. It is certain that, both during the first invasion of the ice-cap and its ultimate retreat, its outer limits must have been subject to very great oscillations. We know that, in Greenland, parts of valleys which for hundreds of years were covered with vegetation, are sometimes invaded again with ice, and that lacustrine deposits must arise in this way between purely moranic deposits same must have taken place in the Ice-cap of Russia; and the oscillations of the glaciers on the outer border of a large icecap are on on a much greater scale than the oscillations of isolated glaciers in Aloine regions. When the ice-can began to invade Middle Russia, its advance was undoubtedly accompanied by many oscillations : regions invaded by see must have been set free of lee for a succession of years, and they became the seats of lakes. The same oscillations must have taken place during the retreat of the ice-cap. The existence of a warmer inter-glacial period, therefore, though not improbable in itself, can be proved only by means of a very wide exploration of the boulder-clay, and such an exploration has not yet been made

This system of meteorological observation in Alisace-Lorrane has now been centrilised, a neteorological servee for the Reichland having been established. The control of the new service has been instructed to the geographical remarks in connection with the Strasburg University, and has been definitely understood the strasburg University, and has been definitely understood that the strasburg University, and has been definitely understood that the strasburg University, and has been definitely understood that the strasburg University of the Strasburg Universit

A REMARKABLE series of three hailstorms which passed over Graz on August 21 last year, about 5, 6, and 7 pm re spectively, has been carefully studied by Prof Prohaska (Met. Zeits.) Stones from 1 6 to 2 4 inches in diameter fell in the town, forming a compact ice-mass, in some places about 3 feet thick, and a white cloud of vapour formed over the ice. It is noteworthy that all three storms took a nearly quite straight path over mountain, valley, and plain, no influence of mountain, on the direction was perc public. The advancing strips of hail were 10 to 14 km in width , the first went 173 km east-south east , the second and third almost exactly east, one 110 km , the other 201 km The 70 km stretch of country from Stiwoll over Graz to the Hungarian border lay in the path of all three, so the ice deposited by the first offered no hindrance to the others, Mountains seem to have affected the velocity, if not the direction, of the storms, they were passed more slowly than plains or undulating ground (35 km, an hour against 49 km) A violent wind came out from the hail column, a west or northwest wind in front, north on the south side But further out, in front especially, there was a well-marked air current towards the hadstorm, and this was especially sirong on the lee side of a mountain. Whirling movements were not observed, and there was but little thunder and lightning The falls of temperature were very pronounced : eg in the first storm from 26° C to 5°. The barometer went down before each hailstorm, then suddenly

AT the meeting of the Linnean Society of New South Wales on May 27, Mr. Hearty Dease stated that in April, while traveling by sight through the Big Soreb in the Richmond River Daviet, his literate was aroused by the remarkable effect produced by luminous useens which abounded by the rounded driver in the meeting the state of Ceruptana meeting, Sk, which are also phosphorescent, Mr. Fletcher, who had seen the precincular formstade, was of the opinion that these were very repetitions formstade, was of the opinion that these were very

probably also dipterous larve. Mr. David made some remarks on certain luminous organisms which he had observed in old coalmine workings in Illawarra, the Identification of which it was hoped would not long be postponed.

MESSES. CASSELL AND CO. have usued Part 33 of the "New Popular Educator," which is to be completed in forty-eight parts. The present number includes, besides the illustrations in the text, a coloured representation of insectivorous plants.

THE first volume of Messrs. Whittaker's new "Library of Popular Science" will be an elementry introduction to astronomy, by Mr G. F. Chambers. The volume will be ready in the course of a few weeks, and will shortly be followed by others.

An interesting report, by Mr Campbell, of the British Consular Service in China, has been issued by the Foreign Office It is the record of a journey of over 1300 miles in districts in Northern Corea, many of which have never before been visited by Europeans Mr Campbell started from Seoul, the capital, and crossed the peninsula to the treaty port of Won-san (Gensan). and thence pursued his way along the east coast around Broughton Bay, whence he turned north-eastward, crossing the Yalu River to Park tu-San, known to Europeans as the Long White Mountain, and already visited by Messra James, Fulford, and Younghusband The return journey was partly over the same ground, but on arriving at Won san Mr Campbell recrossed the peninsula, and so made his way to Seoul Besides the ordinary record of this journey Mr Campbell gives a great amount of information on various subjects connected with Corea. The chief amongst these is a most interesting section on the prevalence of Buddhism in the pennisula, and one on the agriculture and productions He gives a good deal of information in regard to the geography of Northern Corea, and also of the gold production of the country That Corea contains gold-bearing strata has long been known through the export of gold dust from the ports, but from Mr Campbell's report it appears that gold-fields do exist in considerable numbers, and that some of them are worked with the imperfect native methods doubt that, if circumstances were favourable to the proper scientific working of the Corean gold-fields, the country would be one of the principal producers of the precious metal in the world Education in the country seems to be at a very low ebb, and is confined to a knowledge of Chinese All energy and enterprise is crushed out by an all-pervading tyrannical officialism, and poverty and squalor are universal

THE new reports of the Inspectors of Sea Fisheries are interesting chiefly for the observations of Mr Fryer on the oysler fisheries. He mention the appearance of a curious disease in the neighbourhood of the Thames estuary. in the course of which the shells become so rotten that they will not bear the pressure necessary to open them. The oysters themselves were in good condition, but their round shel's, which were muddy, were completely tunnelled in all directions, while the flat valves, which were clean, were unimured. This points to the conclusion that the ravages were caused by some enemy working from below. The borings were not, Mr. Fryer says, those of either Cliona or whelk-tingle, and it seemed probable that they were the work of a minute Annelid which was present in abundance in the interstices of the shells, and in the adherent mud. In a further example sent to him in June no worms were present, although the oyster-shells were similarly undermined; but their place was taken by larve closely resembling, if not identical with, those of the worm Polylora ciliata A means of guarding against its ravages, suggested by Mr Fryer, is the use of an apparatus recently invented by M Bouchon Brandely, and employed in some of the French oyster earcs for the pur-

pose of facilitating the growth of oysters. This consists of a series of shallow flat baskets or trays of wire-netting on an Iron frame, about 4 inches deep and 2 feet square, placed in tiers. and held together by two iron bands, the number depending on the depth of water in each case. These are either fixed to the soil, or suspended from rafts or other floating bodles, by which means depths of water otherwise inaccessible can be utilized. The other advantages claimed for the apparatus are economy of space in "planting" oysters, and of labour in collecting them. protection of the ovsters from five-fingers, and from contact with unsuitable soil, and their exposure on all sides to the free circulation of the water, resulting in more rapid and regular growth, and a greater tendency to depth of shell than under the most favourable of ordinary circumstances. In the case of beds infested with the boring worm referred to, the trave in question would in all probability afford a ready means of placing the ovsters beyond the reach of these marauders. The convenience of such appliances, especially in cases where French ovsters are laid down temporarily on English beds, to be afterwards transferred to other grounds, e.g during the winter, would probably be found to be very great,

Ar a meeting of the Chemical Society held on June 18, a paper was read by Ludwig Mond and F Quincke, on a volatile compound of iron and carbonic oxide. The authors describe experiments from which they conclude that iron forms a volatile compound with carbonic oxide of the formula Fe(CO), corresponding to that of nickel Very finely divided iron-obtained by reducing iron oxalate by hydrogen at a temperature but little exceeding 400°, and allowing it to cool to 80° in hydrogen - when heated in an atmosphere of carbonic oxide gave a gas which burnt with a yellow flame, and on passing the gas through a heated tube a mirror of iron was formed at between 200° and 380°, while at higher temperatures black flakes of iron and carbon were deposited. Only about 2 grams of iron, however. were volatilized after six weeks' treatment of 12 grams of the metal: it was necessary every five or six hours to interrupt the operation, and to re-heat the iron to 400° in hydrogen during about twenty minutes. When passing carbonic oxide at the rate of about 21 litres per hour, not more thin o of gram of iron was volatilized, corresponding to less than 2 c c. of the compound Fe(CO), in a litre of gas. The authors have effected an analysis of the compound by passing the mixture of gases into mineral oil, boiling between 250" and 300", and heating the solution so obtained to 180°, 1ron free from carbon is then deposited and carbonic oxide gas is evolved Five analyses are quoted, the results of which give a ratio of Fe CO, varying only from I 403 to 1 . 4 264. Dr Armstrong said that the authors' discovery was extremely interesting on account of the explanation which it might be held to afford of the permeability of iron by carbonic oxide at high temperatures, as well as to the production of steel by the cementation process, to which Graham had drawn special attention. Just as platinum was permeable by hydrogen and silver by oxygen at high temperatures, so iron was permeable by carbonle oxide, it might be supposed, in each case, because a dissoclable compound of the metal with the gas was formed. Prof Thorpe drew attention to the value of the experiments in connection with the production of steel by the cementation process. and stated that he had recently observed that platinum had the property of causing the separation of carbon from carbonic oxide. Mr. Mond said they had refrained from discussing the application of their discovery in the directions indicated, as the compound was only obtained at low temperatures. Dr. Armstrong said this might well be the case , but as Mr. Mond and Dr. Quincke had established the all-important fact that iron had a specific affinlty for carbonic oxide, the argument he had used would apply, although the compound might not be sufficiently stable at high temperatures to exist alone.

NO. 1132, VOL. 44]

THE additions to the Zoological Society's Gardens during the past week include a Chimpansee (Anthropopithe us tregledyles &) from West Africa, presented by Major Al. McDonnell Moore: a Duyker Bok (Cephalophus mergens &) from South Africa. presented by Mr A. Barsdorf, five West Indian Ascortis (Dusyprocta antillensis) from Jamalca, presented by the of Governors of the Institute of Jamaica; a Spotted Cary (Calogenys paca) from Guiana, presented by Mr. R. Kirk; two Slow Lons (Nycticebus tardigradus), a Javan Fish-Owl (Retute javanensis) from Java, presented by Mr. R. Dixon : an Oran cheeked Waxbill (Astrelda meltoda), a Zebra Waxbill (Estrelda subflara) from West Africa, a Nutmeg Finch (Munia punctularge) from India, presented by Mrs. Harris . a Chattering Lore (Lorsus garrulus) from Moluccas, presented by Miss Allce Dundas , a Common Viper (Vipera berus), British, presented by Mr W. H. B. Pain , four Grey Parrots (Pisttacus erithacus) from East Africa, deposited : a Thar (Capra semiasca), born in the Gardene

OUR ASTRONOMICAL COLUMN.

LUMINOUS OUTBURST, OBERTYRO ON THE SUN.—Compties, reduct for Jane 22 contains the information that on June 17, at 10h 16m. Turn mean time, M. Prouvelot observed a luminous unbest on the van. apparently of the same character as that control to the control to the same character as that the control to the co

LORD HARTINGTON ON TECHNICAL EDUCATION.

THE fourth annual meeting of the National Association for the Promotion of Technical and Secondary Education took place on Friday last at 14 Dean's Yard, Westimister Lard Hartington, President of the Association, occupied the chair. He said:—

In opening the proceedings it will be, fortunately, unnecessary for me to trouble you with more than a very few brief observations. It has not been considered necessary to make any attempts to obtain a very large attendance to day, or to meet in any place where we could have a meeting on the scale of others which we have had on this subject in previous years, not but that we have arrived at a very important epoch in the development of the objects for which this Association was founded lopment of the objects for which this Association was sounced four or five years ago. It may, perhaps, be desirable for me, in the first place, to call your attention and the attention of the public to the special objects for which this Association has been founded, as I think there is in some quarters some missapperhension as to the practical nature of the objects which we have in view. As is stated in the report, its object has not been to interfere with the teaching of trades in workshops, or with the industrial and commercial training in the manufactory and in the warehouse. It desires, first of all, to develop increased general dexterity of hand and eye among the young, which may be especially useful to those who have to earn their own lively hood, and at the same time improve rather than huider their general education, secondly, to bring about more widespread and thorough knowledge of those principles of art and science which underlie much of the industrial work of the nation , and, thirdly, to encourage better secondary instruction generally, will include more effective teaching of foreign languages and science, for those who have to guide our commercial relations abroad and to develop our interests at home. Now, those are the objects to carry out which this Association was founded. At the time when it was first originated, these objects were very little recognized in any quarter. They were not recognized as in any degree the duties of the State, except to a very limited extent, so far as the opera-tions of the Science and Art Department were concerned But, useful and valuable as has been the teaching carried on under the guidance and direction of the Science and Art Department up to a very short time ago, I think it may be said that scarcely any attempt had been made to give to that teaching a practical application, or to apply its instruction to the advancement and improvement of the industries of the country. Well, the absence of any State recognition was not to any large extent sup-lied at that time by private efforts. It is quite true that a few manu-facturers in different parts of the country had set the very useful example of establishing, in connection with their works, some technical and scientific teaching. There were also a few institutions, such as the well known Polytechnic Institution for the City and in various other parts of the country, which were making attempts to give instruction with the objects which were making attempts to give instruction with ine objects which I have just enumerated, but those efforts were rather of a philanthropic than of a practical character, and they had not lorur of five years ago attained a very large or extensive development. Well, we may look back now at those years as years of very great and very satisfactory progress. I will not say all that years are proposed to the proposed of the prop has been done has been done in consequence of the exertions of this Association Certainly these objects have been greatly advanced since the foundation of the Association, and, we flatter conrelves, to a certain extent in consequence, of the efforts of the Association But whether the progress that has been made has been in consequence of, or independent of, any exertion of ours, it is equally a matter of compratition that progress has been made. In the first place, those objects to which I have already to the control of the progress ourselves, to a certain extent in consequence of the efforts of the principle was for the first time admitted; but a very much greater step was taken in the next year, 1890, when, under the Local Taxtion Act, a sum very nearly approaching £750,000 for England and Wales was placed at the disposal of local authorities, mannly for the objects which this Association of the sum has moved. It is quite true that the application of that sum power of local authorities in whose hands it with placed to apply it in aid of the race or to other purposes, but the efforts of the Association were directed, as I think I shall be able to show you, with very great success, in order to secure the appropriation of these large funds to the purposes of practical technical instruction. You will recollect that in the winter of last year—I struction. You will recollect that in the winter of last year—I think in December—an important conference was held under the direction of the Executive Committee of this Association at the rooms of the Society of Arts, in which members representing County Councils in various parts of the country entered lato conference and discussion with the Executive Com-

mittee of this Association. Information was given as to what had already been done by certain County Councils which had taken the lead, and suggestions were made as to the manner in which other Councils could most usefully follow their steps and devote these sums to the purposes for which we believe they were intended by Parliament. The results which have already been accomplished are recorded in the ort of this Association, which will be immediately circulated Of County Councils in England, excluding Monmouthshire, 37 Of Courty Councils in England, excluding Monmouthabite, 37 have already decided to give the whole of this grain for the purposes of technical instruction. S have decided to give a part of the purposes of technical instruction. S have decided to give a part of the same purpose, and 2 only have decided to apply the whole of it in aid of the rates. In Wales and Monmouthabite it County Councils have, given the whole to the county for the part of the wales of the county for the first part of the wales of the county for the first part of the first part of the county for the first part of the first p funds to educational purposes, and 3 have devoted a part to the same objects. In Wales 2 county boroughs have devoted the whole of the fund to education, and none to any other purposes. With regard to 23 county boroughs, either we have not sufficient want regard to 23 county boroughs, either we have not sufficient information, or they have not yet arrived at a conclusion apon the subject. Well, that appears to us to be an extremely encouraging result so far as it has gone. The exertions of the Exercise Committee have not, however, been entirely confined to securing this appropriation of the funds placed at the disposal of the Countils by Parliament. The same genitemen who have taken the least in the matter from the beginning—I refer chiefly to my friend Sir Henry Roscoe, Mr Acland, Mr. Hobhouse, and others—have obtained from l'arliainent additional legislation considerably extending and developing the principle which for the first time received the assent of Parliament in 1880. think it is hardly necessary that I should give further informa-tion as to the effect of the amending Act of this session tion as to the effect of the amending Act of this session j prefer to leave the guiltenen I have named to give that ex-planation. But I desire, however, to point out that the work of this Awocation, which has been so uccessfully begun, has not by any means yet ended. The application of these grants in the various localities; to Gourse, a work of great variety and of the utmost importance Fortunately, I think, the State has not undertaken, except under very wide conditions, to exercise any supervision over the application of these funds. In a country prosessing industries of so extremely varied a cha Country possessing industries of so extended varieties where a racter as our, it would have been amost undestrable, and I think certainly would have been most undestrable, that any cut and dried system should be ad pted by which one identical, application of public money to purposes of technical instruction should be adopted all over the country. The applimentation smouto ne acopten an over the country. The appli-eation of these funds must vary very greatly in agnetitural districts, and in agricultural districts themselves as between arable and dairy or cheevemaking districts It must vary in those districts which are chiefly devoted to cotton and woollen modulture, and those substantials. industries, and those which are chiefly employed in the coalmining, metal, or chemical trades, and in almost every different mining, metal, or chemical trades, and in almost every different county of England a different application of those resources would have been required. I think very wide discretion has been very wisely left by Parlament to the local authorities themselves, which are in this instance County Councils or county. borough councils. And these Councils have again adopted the wise course of appointing committees to prepare schemes for the approval of the Councils for the application of these grants. he work was, of course, very new to a great many who had to take it up, and this Association has been able, we think, to give valuable assistance to them, both by affording information and valuable assistance to them, both by anothing into mattol and giving advice, and, above all, by providing the means of com-munication between those who are interesting themselves in this work in various parts of the country, to enable them to know what other authorities were doing, what difficulties were found, what means had been found of surmounting those difficulties, and of generally taking counsel and acting together in eo opera-tion Now, the subject of agricultural education, which up to a very short time ago had been almost entirely neglected, has been by many Coniny Councils vigorously taken up. Couries of instruction in elementary science applying to agricultural pursuits have been instituted, and sho instruction of a still anote precised character, in the slope council process of the still anote process of the still anote that the still anote of the still anote that the still anote t has been by many County Councils vigorously taken up. Courses

the desire of the County Councils to Improve the agricultural educa-tion of their districts will be provided. I am glad to say also that the Important subject of the technical education of girls as well as boys is receiving almost universal attention from County Councils Suggestions have been made by this Association, which have in Suggestions have been maje by this Ausociation, which have in most cases received attention, to privide not only for the in-struction of the boys, but also of the girk, in such subjects as cookery, laundly-work, and dary management. In all these matters the Association has been able to give some substance, and the third with their remains a great deal still in which they will be able to afford the same nature and description of they will be able to afford the same nature and description of assistance I need not say, ladies and gendlemen, that for a very considerable time the work which is likely to be thrown upon that Association will be work which cannot be conducted without considerable financial resources. The income of the Association is not a very large one. We have made an appeal Association is not a very large one. We have made an appeal to many of those who throughout the country have literested themselves in this work in connection with County Councils, and we have received very liberal assistance. I think, however, the time has come when we may hope that the efforts which have been made will be to a certain extent, still more than they have been made will be to a certain extent, still more tank ney have higherto been supplemented by the assistance of gentlemen connected with the great manufacturing, mining, and commercial industries of the country, who are likely, I think, to derive at least as much benefit from the operations of this Association, least as much benefit from the operations of this Association, and from the development which it has aided in giving technical instruction throughout the country, as the agricultural industry has already received. Ladies and gentlemen, I must apologue to you for the imperfect character of these observations, which I have been obliged to condense as much as possible, as my time, and I date say yours, is extremely hmited I only hope that any omissions which I have made will be supplied by my

friends who are on each side of me Sir H. Roscoe, M.P., presented the report of the work of the Association during the past year He said that there was no doubt that during the year a very great expansion of the work of the Association had been seen under both the Acts of Parfiament to which reference had been made by the Chairman The spread of technical education throughout the country had been most remarkable. From what had already been said by been most remarkable. From wan an arrestly been said by Lord Hartington, it would be concluded that practically the whole of England had devoted the whole of the money to technical instruction. The effects of this could scarcely be over-estimated The only two places where the money had been devoted to the relief of the rates were, he regretted to say, London and Middlesex. But it should be borne in mind that what had been already accomplished was nothing to what re-mained to be done. The County Councils were as yet only breaking the ground. Their efforts were merely tentative They had, as it were, to work out their own salvation in this They had, as it were, to work out their own salvainon in this matter of elicitation, and there was certain to be at no great matter of elicitation. The state of the salvaint Shire had been able to vote money to assist the Yorkshire College in its scheme for the improvement of agricultural education Many of the County Councils had already appointed caucasion army of the County Councils had already appointed organizing secretaries, and twas on these that the main part of the work would fall. To them they had to look for the special organization of each particular district, and the importance of their work could scarcely be overrated. Then in the county of the county o their work could soarcely be overrated. Then in the county broughts the work was foring got into shape. In Sheffield a sum of £8495 had been appropriated towards assisting instan-tions groug technical and secondary education. In the same way in Manchester £10,000 had here devoted to a like purpose Agrenitural electration was making rapid progress, and already the standard of the same properties of the same properties of the same properties of the same properties of the same high client springly the same properties of the same properties of 90 some part of the money being devoted to be technical inof some part of the money being devoted to the technical in-struction of girls, he concluded by expressing the hope that the Association would be placed in a position by an increase of its resources to carry on actively a work that was daily becoming

on the motion of Mr. H. Hobhouse, M P., seconded by Lord Thring, the report was unanimously adopted

Lord Hartington at this point left the chair, which was taken

by Sir Bernhard Samuelson Lord Monteagle moved the reappointment of the vice-pre-

NO. 1132. VOL 447

adds, recently committee, and efficers of the Association, the second of St. 1900 and 1900 an

work until the country is provided with an organized system of secondary and technical education."

Miss Hadland seconded the resolution, which was agreed to, seconded, a vote of thanks to the Charman, and this having to a vote of thanks to the Charman, and this having been hearthly accorded was acknowledged by Sir Bernhard Semuelson.

The proceedings then terminated.

SCIENTIFIC SERIALS.

In the Journal of Bolasy for May, Prof R J Harvey Gibson has an interesting article, illustrated, on the histology of Polysyshowns distinguist in the June number, Mr. A. W Bennett contributes a short paper on excasility aways the Conjugate These numbers also contain continuations of Mr. E G. Baler's synopsis of the genera and species of Malvex, and of the Rev H G Jameson's useful key to the genera and species. of British mosses.

THE papers in the Botanical Gazet's for April and May are concerned almost exclusively with American botany Mr. D. M. Mottier has an interesting note on the apical growth of Hepitice, which bears such a striking resemblance to that of the prothallium of ferns.

THE number of the Nuovo Ginnile Rolance Italians for April is chiefly occupied by papers of special interest to Italian hotanists, and by the Bulletin of the Italian Botanical Society Among the articles coming under the latter head is one by Sig Baccarni on the secretory system of the Papilionace, and one by Sig Pichi containing an account of experiments on the parasitism of Peronospora on the vinc

THE Botanual Magazine of Fokyo still contains occasional articles to the English language. Those in the numbers most recently received, for March and April, relate to the native plants of Japan.

SOCIETIES AND ACADEMIES. LONDON,

Royal Society, June 11 — "A Study of the Planté Lead—Sulphuric Acid—Lead Peroxide Cell, from a Chemical Standpoint. Part 1" By G H Robertson. Communicated by Prof. Armstrong, F.R. S

The investigation, the results of which are recorded in this paper, was instituted about a year ago at the Central Institution, at Dr. Armstrong's suggestion, as McLeod's observations on the electrolysis of sulphune acid solutions led to the supposition

the electrolysis of sulphane acid solutions led to the supposition that the changes occurring in the acid were probably less simple than was commonly supposed. This supposition was verified. The first extent of the paper deals with the nature of the lead salt formed during discharge. Experiments made on various samples of red lead of different percentage composition showed that, as with nitne, so with sulphuric acid, it behaved

showed that, as with inter, so with sulphure acid, it behaved the a mature of percide and monoutie, the valphure formed always corresponding to the monoude originally present. As analysis allone can give no proof of the existence of a definite homogeneous sulphate corresponding to red lead, reduces must be obtained that the product different is some of the properties from a military of the product different process that the product of the properties of the product different process that the mixture of sulphage and overcords and have some admired sulphage. E.M.F. of an oxysuipnate would filter from a corresponding mixture of sulphate and personde, and have some definite value, but experiments made with mixtures of sulphate and peroxide in different proportions, and with the product obtained by treating red lead with dilute sulphuric acid, showed that there was a difference of degree only between the red lead pastes and the mixtures.

With regard to Frankland's observations respecting the

colour of the product formed on the peroxide plate during discharge, and the reducibility of the sulphate, the author points out that the colour is due to the incomplete reduction of the peroxide; and that careful examination of the plugs from or the perusaue; and that careful examination of the plugs from a duscharged cell shows that the base consists of practically unlicered peroxide of lead, and that the surface, which is rich in PbSO_a is really a mass of partially reduced granules of peroxide of lead which are coated with sulphate

or team which are coated with supprate a very difficult to reduce, it is well known that mixtures of lead sulphate and peroxide of lead, or other conducting substances, are reduced with comparative case, and that it is very minimate mixtures of this nature

which have to be dealt with as a rule in charging a cell In conclusion, the author points out-

In conclusion, the author points out—

for conclusion, the author points out—

for That neither chemical not electrical test give any ground for

the conclusion of the conclusion of the conclusion of the conclusion

to concerned in the unreaction occurring in the cell.

That were the sadden lowering of the E MF, caused by a

change in the nature of the chemic-! compounds formed on the

plates, it is very difficult to account, for the very rapid recovery

of the E M.F exhibited by an apparently discharged cell.
In the second section the electrolyte is dealt with, and, after referring to the work of Berthelot, Richarz, Schone, Traube, and others on the electrolysis of sulphuric acid solutions, the author outers on the electrolysis of sulphuric acid solutions, the author describes experiments made to test the effect of the addition of sodium sulphate to the electrolyte, as recommended by Mr Barbour Starkey, as it seemed probable it had a catalytic action on the "peroxides" always found in electrolyzed acid of the strength used in batteries

Mr. Preece most kindly aided the investigation by allowing experiments to be carried out at the General Post Office, where experiments to be carried out at the General Post Office, where one-half of the secondary cells, contain 1 per cent of sodium sulphate, and the other half ordinary dilute acid, sp. gr. 180 it was found that the addition of sodium sulphate in about the proportion of 1 per cent to freshly electrolyzed, acid, or during electrolyzed, wasys produced a diminuation in the total quantity of "active oxygen," and brought the amount present in the plain cells down almost exactly to that found in the volume sulphate

Determinations were made of the amounts of "active oxygen present as persulphuric acid and hydrogen dioxide respectively, and it was established that acid taken from the cell reduced peroxide of lead. The presence of hydrogen dioxide being thus peroxide of fead. In the presence of hydrogen dioxide being thus catabilished both directly and indirectly, its effect on the L M F of a cell was tested. It was found that, while the addition to the acid in the case of a lead head-peroxide couple in idiate sulphuric acid produced an annulment, or reversal, of the L M F, the introduction of hydrogen dioxide into the body of the peroxide paste produced an increase in the E M F in the case of a platinum lead peroxide couple.

The Post Office records showed that, while the general cha-

racter of the temperature and specific gravity changes occurring during charge and discharge were the same in both types of cell, there was less sulphating with the sodium sulphate elec-

trolyte. The cause of the pink colour of the acid, noticed by Mr.
Crompton and others, was investigated, and found to be per-manganic acid, formed probably from the manganese present in commercial lead

commercial tead
In conclusion, the author points out—
That peroxides are found in appreciable quantities in the
electrolyte during charge and discharge;
That their influence aust not be neglected in considering the

behaviour of the Planté cell ; And that it is to the electrolyte, rather than to the plates, that attention must be directed if any considerable improvement is to be effected.

"Part II.-A Discussion of the Chemical Changes occurring in the Cell," By H. E. Armstrong, F.R.S. and G. H. By H. L Armstrong, F.R.S. and G. H.

The authors arrive in this paper at the following conclusions The subors arrive in this paper at the following conclusions— (1) That the cooling observed in the Plantic cell can only be explained as resulting from the dissociation of the dilute sul-strainty, and Woods are in practical agreement with those calcu-lated on the assumption that the acid used is sulphure acid listed, H₃SO₄, that in all probability such acid, and not the dilute acid contained in the cell, is operative throughout. (2) That the observed loss to efficiency cannot be due to tem-

perature changes, as these arise through actions occurring out of

circuit (3) That it is difficult, from a comparison of calculated with observed values of the L M F, to arrive at any find conclusion as to the exact nature of the changes which take place in the cell. On the assumption that sulphating occurs at hoth plates in circuit, and under the influence of IL₂SO₄, the calculated value is considerably too high, while, it sulphating occur only

value is considerably too high, while, it sulphating occar only at the lead plate, the value calculated is far too lovel (4). That a counter E. M.F. of about 0.5 voit would account for the observed departure from the highest calculated value. As percoades are always prevent in the electrolyte, it is concertable that such a counter E. M.F. may east, uncorever, there is also the possible influence of the lead support to be convoliered (5). That the observed loss of efficiency is to be attributed to

the formation of peroxides in the electrolyte, and to the excessive sulphating occurring chiefly at the peroxide plate in the local circuit existing between the support and the paste

June 18 — "Comparison of Simultaneous Magnetic Disturbances at several Observatories, and Determination of the Value of the Caussian Coefficients of Those Observatories". By 1rof, W. Grylle Adams, D.Sc., F.R.S., Profestor of Natural Philosophy in King's College, London.
After drawing attention to previous investigations on this

subject, and pointing out the importance of adopting the same scale values for similar instruments at different Observatories, especially at new Observatories which have I een recently established, the discussion of special magnetic disturbances is entaitished, the discossion of special magnetic disturbances is undertaken, especially the disturbances of a great magnetic storm which occurred on June 24 and 25, 1885, for which photographic records have been obtained from 17 different Oliservatories: 11 in Europe, 1 in Canada, 1 in India, 1 in China, 1 in Jan, 2 at Mantitus, and 1 at Mebourne.

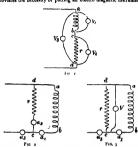
The records are discussed and compared, tables are formed of the amultaneous disturbances, and the traces are reduced to

Greenwich mean time and brought together on the same plates arranged on the same time-cale. Plates I, and II show the remarkable agreement between the disturbances at the different Observatories, and the tables show that the amount of dis-turbance, especially of horizontal magnetic force, is nearly the same at widely distant stations

An attea-pt has also been made to apply the Gaussian analysis to sudden magnetic disturbances, and, with a view to their application in future work, the values of the Gaussian coefficients have been obtained for 20 different Observatories, and the numerical equations formed for the elements of magnetic force in three directions mutually at right angles, and also the equation for the magnetic potential in terms of the Gaussian constants to the fourth order

The tables give the numerical values to be multiplied by the 24 Gaussian constants to give the values of the forces X, V, and Z in the geographical meridian towards the north, perpendicular to the meridian towards the west, and towards the earth's centre to the mendian towards the west, and towards the earth's centre respectively. The equations are also formed and the values obtained in terms of the 24 Gaussian constants for λ_p , λ_p and λ_q . λ_p being the horizontal force in the magnetic mendian, V_q , the horizontal force perpendicular to the magnetic mendian, and λ_q the vertical force. If then X_p , V_q , and Z_q be the observed values of any simultaneous disturbances, they may be at once substituted in the equations, the equations giving the 24 Gaussian constants may be solved, and the corresponding change of magnetic potential may be determined

Physical Society, June 12, 1891 -Prof W F Ayrton, F.R.S., President, in the chair.—Prof. W. F. Ayrton, F.R.S., President, in the chair.—Prof. W. G. Adams took the chair whilst Prof. Ayrton read a paper on alternate current and potential difference analogues in the methods of measuring power, by himstelf and Dr. Sumpmer. In a paper read before the Society in March last, the authon pointed out that, for every method of measuring power in which readings of that, for every method of measuring power in which readings of voits and suppers were taken, other methods in which ampieres of the method of the suppers of the supers of the supers of elevated. More recently, Dr. Flening had, by a transformation of a formula given by the authors an communication made to the Koyal Society on the measurement of power by three volt-the koyal Society on the measurement of power by three volt-heydown and the suppers of the supers of the suppers of the polyed. The two arrangements are represented in Figs. 1 and 2, whilst Fig. 3 shows a modification of Dr. Flening's method (Fig. 2, la which the current in the non-inductive resistance r is measured by the aid of a voltmeter V across its terminals. This obviates the necessity of putting an electro magnetic instrument



in what should be a non-inductive circuit. The formula for the mean watts spent in the circuit ab, Figs. 1 and 2, are respectively—

spectively—
$$W = \frac{1}{2r} \left(V_1^s - V_1^s - V_2^s \right), \text{ and } W = \frac{r}{2} \left(A_1^s - A_1^s - A_2^s \right).$$

Mr. Blackely's method of measuring power by a split-dynamonice was above to be analogous to the original electrometer method in which the difference of two readings was proportional to the power, and Blondiot and Currie's double electrometer method was shown to be the analogue of the ordinary swattmeter method was shown to be the analogue of the ordinary swattmeter The wattencier was effective in the fact that a subnordal cost was introduced is, as was shown by one of the authors some years ago, expressed by the formula—

Apparent watts =
$$\frac{1 + \tan \theta \cdot \tan \phi}{1 + \tan^2 \phi}$$

where 8 is the phase angle between the current and E M F the circuit in which the power is to oe measured, and o the phase angle for the approximately non-inductive circuit. now proved that the same formula expresses the error in any of the methods where resistances not wholly non inductive are used. the methods where resistances not wanty from inductive are used.

As is well known, Mr. Blakesley has applied his split-dynamo meter to the measurement of phase differences between two currents, and an analogous method of finding the phase difference between two potential differences is described in the paper. In this method a high resistance split-dynamometer such as suggested by Mr Rimington for measuring power is employed. Blondlot and Currie's double electrometer could also be used for the and Currie's double electrometer to the same purpose Numerous diagrams illustrating the various whether hot wire voltmeters could be employed to measure the various potential differences, without introducing error. In reply, Prof Ayrton said that, although no great error was introduced by the self-induction of these instruments, yet the fact that they required considerable current was a disadvantage, and as these currents were not always in the same phase as those in other circuits, troublesome corrections were sometimes necessary Electrostatic instruments were preferable Prof. Adams said he was glad to hear that the inductance of Cardew volumeters introduced no serious error, for they were very convenient instruments to use.—Prof. O. Lodge, F.R.S., exhibited and described a clock for pointing out the direction of the earth's orbital motion in the ether. After mentioning the various motions to which a point on the earth's surface is subjected, he pointed out that the orbital motion was the largest component, and its direction at any in-stant not easy to conceive. An apparatus for pointing out this direction was therefore convenient when dealing with problems

requiring a knowledge of the motion of a point through the ether. In one of two clocks shown, one spindle representing the earth's polar axis and another the axis of the coliptic were inearth's polar axis and another the axis of the ecliptic were in-clined at an angle of 33%; and coupled by a Hooke's joint. The latter axis was capable of rotating round the former. At its upper end the ecliptic axis carried a tube and a pointer, both being perpendicular to the axis and to each other. The clock keeping solar time rotated both axes, and when property set the tube pointed in the direction of the sun, and the pointer therefore in-dicated the direction of the earth's orbital motion —Some experiments with Leyden jars were then shown by Dr. Lodge. The first one was with resonant jars, in which the discharge of one jar precipitated the overflow of another, when the lengths of one jar presunsted the overlies a allosted or tuned. The latter jar was entirely disconnected from the former, and was influenced merely by electro-magnetic waves emanating from the discharging circuit. Lengthening or shortening either circuit prevented the circuit. Lengthening or snortening either circuit preventes the overflow. Correct tuning was, he said, of great importance in these experiments, for a dozen or more oscillations occurred before the discharge ceased. The effect could be shown over considerable distances in connection with this subject Mr. Blake-ley had called his attention to an observation made by Priestley many years ago, who noticed that, when several jara were being charged from the same prime conductor, if one of them discharged the others would sometimes also discharge, although they were not fully charged. This he (Dr. Lodge) thought might be due to the same kind of influence which he had just might be due to the same kind of influence which ne nau just shown to exist. The word retenance, he said, was often minderstood hy supposing it always had reference to sound, and as substitute he thought that symphomic or symphomic might be allowable. The next experiment was to show that wires might be tuned to respond to the oscillation of a jar discharge just as a string could be tuned to respond to a tuning-fork thin stietched wire was connected to the knob of a jar and ann arrefered wire was connected to the knob of a jur and another parallel one to its outer coating, and by varying the length of an independent discharging circuit, a glow was caused to appear along the remote halves of the stretched wirea at each discharge. Lach of the wires thus setted like a atopped organpipe, the remote ends being the nodes at which the variations no pressure were greatest. By using long wires he had observed a glow on portions of them with the internediate parts dark, this corresponded with the first harmonic, and by measuring the distance between two nodes he had determined the wave-length of the oscillation. The length so found did not agree very closely with the calculated length, and the discrepancy he thought due to the specific inductive capacity of the glass not being the same for such rapidly alternating pressures as for steady ones. He also showed that the electric pulses passing along a wire could be caused (by tuning) to react on the jar to which it was connected, and cause it to overflow even when the which it was connected, and cause it to overflow even when ine distance from the outside to the inside costing was about 8 inches. During this experiment he pointed out that the noise of the quark was greatly reduced by increasing the length of the discharging circuit. The same fact was also illustrated by causing two jars to discharge into each other, spark gaps being put both between their inner and outer coatings so as to obtain between their inner and outer coatings so as to obtain "A" sparks and "B" sparks by putting on a long "sliernative path" as a shunt to the B spark gap and increving that gap, the noise of the A spark was greatly reduced. He had reason to believe that the B spark was a quarter phase behind the A spark, that the experimental proof had not been completed. He next described some experiments on the screening of electro-magnetic radiation, in which a Hertz resonator was surrounded by different admitton, in which a Hetti re-onator was surrounded by different auternals. He had found no trace of opacity in missione, but missioned to the surrounded of the surrounded of the con-reconator. Cardboard rubbed with plumbage also acted like a nearly perfect screen. In connection with resonator, he ex-lubited what he called a graduated dictive or or an advire hard-er of the surrounded of the surrounded of the surrounded of of different length are attached to glass plate, and have spark gaps at each end which separate them from other pieces of foll. One or other of the strips would respond according to to the frequency of the electro-magnetic radiation falling upon it. Mr. Blakesley asked whether the pitch of the resonant pars altered when the distance between their circuits was warred, for according to theory the mutual induction should duminsh the self-induction, and cause the oscillations to be more rapid. If this occurred, the method might be used for getting rapid oscillations. He also inquired whether the glow would appear in the same position on the two stretched wires if their

salt were somed. Dr. Sampeer withelt to know how the seatance, indicatence, and chaptent of the circuits and juried statence, indicatence, and chapten of the live of the statence of introduces, and chapten of the live of the statence of irregular distribution of the charges on the title of land been noted. With reference to the overflowing of a jur caused by using a certain only prove the attainer of a higher potential than that which originally existed between the coatings of the jury, and, if so, where did the excess energy come from? Dr. Thompson asked originally existed between the coatings of the jury, and, if so, where did the excess energy come from? Dr. Thompson asked originally existed between the coatings of the jury, and, if so, where did the excess energy come from? Dr. Thompson asked originally existed between the coatings of the jury chapten of the company of the property of the state of the property of the propert

Nonviewal Bouetty, June 16 — Dr. St. Googe Meast, The St. Googe Meast, The St. Googe Meast, The Meast St. Googe Meast Meast St. Googe Meast Meast

Trinklad, of which they had transmitted living examples to the Society Menagers.—Mr F. E. Beddarred some additionation more upon the automy of Hopkinson prizers, made during a nonex upon the automy of Hopkinson prizers, made during a Poulton gave an account of an Interesting example of protective minory discovered by Mr. W. L. Sciater in British Gainan This was an immature form of an unknown species of Homopiers on smeet of the family Membrands, which minute the Coohlie Ant (Exchoma capha deep.)—This meeting closes the present essuion The next season (1891–92) will begin in November season The next season (1891–92) will begin in November

Reyal Microscopical Society, June 17,—Dr R. Brathwatte, President, in the chief —The Preudent and the regretted watte, President, in the chief —The Preudent and the regretted watter, President, in the chief —The Preudent and the regretted watter than the chief of the Preudent and the regretted water Preudent of the Nordy of Merin Duncai, who as a Angainte of Amphylinan prilicules, produced with Zetas and Preudent of NA and coulsely, by Mr T. Comber, of the want of sharpness was due to the employment of a group of the want of sharpness was due to the employment of a group of the want of sharpness was due to the employment of a group of the want of sharpness was due to the employment of a group of the want of the preudent of the manufacture of the waste of the watter of the waste of the wa

the gelatinoses matter to get at the eggs Royal Microstrological Society, June 17, -Mr. Baldwin Latham, Fraudent, in the chart —Mr. A. J. Hands gave an All Microstrological Society, June 17, -Mr. Baldwin Latham, Fraudent, in the chart —Mr. A. J. Hands gave and the state of the chart was the control of the chart was the chart of the chart was the chart of the chart was the helphong struck the condition, a spark passed from it when the hightness graved force of the chart was the helphong struck the condition, a spark passed from the building —Mr. W. Ellis read a paper on the mean temperature of the art at the Royal Olbertson, Greenwish and deduced from the photographic records for the forty years from 1849 to the control of the contr

and the report of the thunder -A paper was also read by Mr. A. B. MacDowall, on some suggestions bearing on weather

Geological Society, June 24.—Sir Archibald Geikie, F R S, President, in the chair.—The following communications were read.—On wells in West Suffolk boulder-clay, by the Rev Edwin Hill. It might be supposed that in a boulder-clay district water could only be obtained from above or from below the clay. But in the writer's neighbourhood the depths of the wells are extremely different, even within very short distances, and since the clay itself is impervious to water, he concludes that it must include within its mass pervious beds or concludes that it must include within its mass pervious recessor seams of some different material which communicate with the surface. It would follow that this boulder clay is not a uniform or a homogeneous mass. The visible sections are only those given, at hand by ditches, and at a considerable distance north and south by pus at Bury St. Edminds and Sudbury The appearances in ineee narmonize with that conclusion. Consciu-tion and appearances differ from what we should expect on the theory that this boulder clay was the product of the attrition between an ice-sheet and its bod. The reading of this paper was followed by a discussion in which Priof Pretwick, Dr. Evans, Mr. Clement Read, Mr Charlesworth, Mr Topley, Mr. Goodchild, the President, and the author took part —On the metaphyres of Caradoc, with notes on the associated felsites, metaphyres of Caradoc, with notes on the sas-clasted felates, by Frank Rulley—Notes on the goodoys of the Tonga Islands, by I. J. Latter (Communicated by J. E. Mars, P. R. S.)—On 1969, the Communicated by J. E. Mars, P. R. S.)—On 1969, the Communicated by Pot. Chas. Lapworth, F. R. S.). In this paper the author gives reasons for supposing that the laverness earthquakes of last year were due to the subandence of a great wedge of rock undusted between a man fault and a branch one, and the considerate that there is fluid to the considerate that the considerate that the considerate that there is fluid to the considerate that there is fluid to the considerate that the considerate that the considerate that the considerate that there is fluid to the considerate that the consideration of the considerate that the considerate that the consideration of the consideratio main fault and a branch one, and he considers that there is tille doubt that these recent earthquakes were the transitory records of changes that, by almost indefinite repetition in long past times, have resulted in the great Highland faults —The next meeting of the Society will be held on Wednesday, November 11

Academy of Sciences, June 29 — M Duchartre in the chair — On persulphates, by M Berthelot. Some new facts are stated in proof of the extentee of persulphare and not merely stated in proof of the extentee of persulphare and not merely ing distinct salls, similar as regards composition for persulpantes, persulphates, parcely better as they pressure and in rapid motion, by M. Ducheve The artificial proof of the persulpantes, persulphates, and persulpagates — Experiments on the mechanical actions exercised on rocks by gas they provide the proof of the persulpagates and in rapid motion, by M. Ducheve The matchy the same height, and points out that h h probable that each group is the result of internal action as one centure. These considerations are applied to old volcame rocks, which often exhibit a market tendency to equality of slevel. The experimental properties of the present of the properties of the properties of the properties of the present of the pr prevously described — Action of sodium alcoholates on campbor-tnew method of preparation of alivi camphon; by M. A. Haller—On a crystogan parasit of locates, by M. C. Haller—On a crystogan parasit of locates, by M. C. Haller systems, by M. S. Mangeov —On homogeneous finishe deforma-tions: energy of an isotropic body, by M. Marcel Brilloun — On the blackal character of compressed quarts, by M. F. Benaliata — The photogenic efficiency of different sources of light, by M. S. Witz —Ou an electro-magnatic beld, by M. M. light, by M A Witz—On an electro-magnetic Dell; by MM Guerre and Martin—Contribution to the study of atmospheric electricity, by M Ch André It is generally admitted that atmospheric electricity is subject to a diurral variation A dissussion of the observations made by M. Mascart at Lyons incre 1834 shows that electric potential varies in much the same manner as barometric pressure and relative humidity. In fact, manner as batometric pressure and relative humidity. In fact, curves showing the annual wrantions of relative humidity and electric potential have precisely the same form —On the coidation of accompands, by M. Chiteria Lauth.—On the formation of the meetitery and the intestinal canal in the embryone of the meetitery and the intestinal canal in the embryone companies. The present of the intestinal canal is the embryone complexes, a new group of parasitic fangi of intests, by M. Alfred Citad —Contribution to the study of the differentiation of the suddedm, by M. Pierre League.—On the destruction of President Schotze, and the contribution of the bestroot, by means of compounds of contributions of the bestroot, by means of compounds of the contribution of the present of the contribution of the contribution of the present of the contribution of the present of the contribution of the

NO. 1132, VOL. 44]

Rancente

Royal Academy of Sciences, April 4 — M. F. Plateau in the chart — On the characteristic property of the common safe of view longuist under the first mutual affiship, Fart Ill., by face of view logical sander their mutual affiship, Fart Ill., by first paper indicated that the common surface of two liquids which ast span one snoher is subjected to a force whose direction is swey from the centre of curvature. In the present note is suther gives some new facts which appear to reader this part upon the surface of distilled water, it slowly breaks up in our law and the surface of distilled water, it slowly breaks up in our law share further and the surface and a pherical drop which discends to the bottom of the containing vessel. It is shown that a flow dimmution occurs of the reamon of the surface shows that a slow diminusion occurs of the tension or the surface common to the oil and water. This diminuston apparently arises from a slow chemical action between the two liquids, and which, if sufficiently prolonged, is manifested by the formation of a thin pellicle separating them. Many such phenomena as these are stated and explained according to the new theory. these are stated and explained according to the new theory,— Fourth note on the structure of the equatorial bands of Jupiter, by M. F., Terby. The surfour englished bands, and to comment upon the structure of Jovann equatorial bands, and to comment upon the structure of Jovann equatorial bands, and to In a recent publication Mr. Kerler has overfooked these obser-vations, and rendered this restification necessary —on the num-ber of awarismt functions by M. Jacques Dursysts—4 propo-tion of the plant Venas, by M. J. Niesting these NATURE, June 18, p. 164)—Commercial calculation of the distances of remarkable points of trangles, by M. Clienten Thirly.

BOOKS, PAMPHLETS, and SERIALS RECEIVED Saum's Kingdom' C.M. Heavy (Paul)—Callicio de Mémores risultà la thyaue, incente i son (Pare, Saum's Villay)—Callicio de Mémores risultà la thyaue, incente i son (Pare, Saum's Villay)—Callicio Parella Derin, C. D. W. H. Beant (Rell)—Practical Escare-Despoyate A. Harries and N. Harries (Paul)—Protected Heavy (Paul)—Report on the Calcala Coal Faiel J. Square (Mengasery, Ah.)—A Report on the Calcala Coal Faiel J. Square (Mengasery, Ah.)—A Report on the Calcala Coal Faiel J. Square (Mengasery, Ah.)—A Report on the Calcala Coal Faiel J. Square (Mengasery, Ah.)—A Report on the Calcala Coal Faiel J. Square (Mengasery, Ah.)—A Report on the Calcala Coal Faiel J. Square (Mengasery, Ah.)—A Report on the Calcala Coal Faiel J. Square (Mengasery, Ah.)—A Report of the Calcala Coal Faiel Coa

CONTRNTS

CONTENTS.	PAGE
The United States Entomological Commission	217
Physical Religion	. 219
The Karwendel Alps. By T. G B	. 221
Our Book Shelf:	
Cremona: "Graphical Statics"-A. G. G	221
Gibbins "The History of Commerce in Europe".	. 222
Letters to the Editor:-	
The Albert University -Prof. E. Ray Lankeater	
F.R S ; Prof. G Carey Foster, F.R.S	. 222
The Draper Catalogue, - Prof Edward C Pickering	
The Cuckoo.—E. W. P.	223
Colour-Associations with Numerals, &c Dr Edward	;,
S. Holden	223
Erratic Barometrie Depression of May 23-29, and	, 20,
Hailstorm of May 24 -B. J Hopkins	224
"An Alphabet of Motions"—J. S. Dismorr	. 225
On a Cycle in Weather Changes.—A B. M.	
The Forecast of the Indian Monsoon Rains. By	225
Physical Science for Artists. II. By J. Norman	. 225
Lockyer, F.R.S.	
Tumbers Claude B. O. Teese	. 227
Lockyer, F.R.S. Luminous Clouds. By O. Jesse. Wilhelm Eduard Weber. By G. C. F.	229
Wilhelm Eduard Weber. By G. C. F.	. 229
A Souvenir of Faraday. By William Crookes	
F.R.S ; F. O. Ward	. 230
Notes	. 231
Our Astronomical Column:-	
Luminous Outburst observed on the Sun	
Lord Hartington on Techical Education	
Scientific Serials	. 236
Societies and Academies	. 236
Books, Pamphlets, and Serials Received	. 240

THURSDAY, JULY 16, 1891.

ORGANIZERS OF TECHNICAL EDUCATION IN CONFERENCE.

HE progress that has been made during the past year by English County Councils in the application of their grants under the Local Taxation Act to purposes of technical education is attested by the map which accompanies the fourth Annual Report of the National Association for the Promotion of Technical and Secondary Education, and which we reproduce. It will be seen from this map that the counties which have determined to use the whole of the new fund for education form a large majority of the whole number both in England and Wales: and that London and Middlesex enjoy an unenviable, and we hope temporary, distinction, in having been the only counties to grab for the rates the whole of the money which might have been used to organize the secondary and technical education of their districts.

But while the map and the Report offer sufficient evidence of the good intentions of the County Councils. the solid progress already achieved is still more emphatically shown by the Conference of organizing secretaries which followed the annual meeting of the Association on the 3rd of this month. The very post of organizing secretary is the creation of the past few months. A year ago no county had dreamt of appointing an official to look after its education, and the Technical Instruction Act was only in operation in a few scattered centres Now nearly twenty counties and county boroughs have special educational departments, with paid organizing secretaries. We need hardly point out the wisdom of making such appointments, in view of the unwonted duties cast on County Councils by recent legislation. The task is one which needs all the ability which is available, and this ability is of a highly specialized character, not to be expected of the average County Councillor or Clerk of the Peace, who besides have not the time for the necessary detailed work of organization To leave the work to clerks would be to court failure, for the work to be attempted within the next few years must be largely tentative, and the direction of the experiments must be in the hands of men of knowledge, ideas, and resource, as well as of tact and judgment.

The selection of such men is not easy, and we are glad to find that the secretaries of the Technical Association are prepared to suggest candidates to County Councils which may be in need of them. The appointments made hitherto have been of two kinds: as temporary organizers, to nquire into claims and applications, to vait every district in the county, and to give any a detailed scheme as the result of such inquiry; and as permanent secretaries to the Technical Instruction Committees, charged with the work of carrying out the schemes and inspecting the instruction, either personally or through the employment of experts.

About two-thirds of the gentlemen who had been appointed up to the date of the Conference accepted the invitation to be present, the district represented being Lancashire, Cumberland, Surrey, Sussex, Derbyshire, Devonshire, Oxfordshire, Nottinghamshire, and Hampshire, besides a few county boroughs. The Conference was private and informal, its object being rather the interchange of views and the comparison of notes than the adoption of any formal resolution.

The subject chosen for consideration was the relation of the local taxation grant to secondary schools-the most difficult, as well as the most important, of the questions with which the organizer finds himself face to face when preparing a scheme. Since Matthew Arnold wrote, the disgraceful condition of secondary education in England has been a common-place; but how inefficient many of the schools are, and what tracts of country are entirely without even such facilities as they offer, is probably scarcely realized by any except those who have made a minute study of the educational wants of an average county. The country grammar-school, with small endowment and ill-paid and lethargic head master assisted by a worse paid and more inefficient usher, is all that stands for secondary education in many a market-town. Many are without even the semblance of a school above the elementary rank, and the mass of the inhabitants, it is to be feared, hardly feel the want of anything more Here and there an energetic master or governing body has succeeded in building up a good school in despite of local apathy and lack of funds, but the fee has to be pitched at a point which excludes wage-earners, and such schools are consequently "middle," not only in the character of their instruction, but also in the class by which they are attended. Meanwhile, the clever boy of the village national school, who might profit the nation by his brains and energy, is doomed, for lack of opportunity, to leave school at twelve for the hopeless rut of farm labour.

A country-side the general education of which is as here described is not a promising field for special technical instruction. A stupid set of uneducated farmers, and a carciely less stupid class of uneducated labourers, form hardly a good soil in which to plant lectures on agricultural chemistry or the natural history of insect pesss. And thus thoughful observers have been driven everywhere to the conclusion, no less in country than in town, that access to good secondary schools is an even more cryzing need at the present day than the specialized instruction to which, indeed, a sound general education is the necessary preliminary.

What, in short, is wanted, is that within reach of every inhabitant of every county should be a good secondary school, with fees such as may be reasonably expected to be paid by small farmers and tradesmen, and to which all some of artisans and labourers who can pass a reasonable examination before the age of twelve can have access by measo of scholarship.

The question before the Conference was the best means of promoting this object under the powers given by the Technical Instruction Acts. It will be remembered that the definition of technical Instruction in the Act of 1889 is sufficiently wide to cover most of the subjects taught in a secondary school, and it is therefore clear that aid can be given to such schools, provided that the County Council can be represented on the governing bodies, and that the schools are not conducted for private profit. As regards the erection of new schools, it is doubtful if the whole work of building could be undertaken, even if desired, by

the County Council, but there is nothing to hinder contributions from being made towards the cost of laboratory, fittings, and apparatus; while a maintenance grant could be given to defray the expense of the teaching of scientific and technical subjects. It was stated at the Conference that the Charity Commissioners had shown every dis-

nicked scholars from elementary to secondary, and from secondary to higher institutions, was unanimously agreed; and it was further considered that the scholarships to secondary schools should not merely defray the fees, but should provide something towards the cost of maintaining the boy while at school. The advantage of choosing the



schemes enabling the County Council to be duly represented on Severning bodies.

But the subject which chiefly occupied the attention of

the Conference was that of scholarships. That some NO. 1133, VOL. 44]

position to facilitate the work, by drafting amending scholars as young as possible, in order to give them the full advantage of secondary training, was also insisted

The question whether the selection of scholars, by examination or otherwise, should be undertaken by the scheme of scholarships should be devised to carry on County Council, or left to the governing bodies of the secondary schools, or to the discretion of the teachers of the elementary schools, elicited some difference of opinion; but on the whole the Conference favoured the plan of examination by a board appointed by the County Council, acting as far as possible in co-operation with the head masters of the secondary schools of the county. On one point all were agreed: viz. that there should be two examinations, or at least two standards-one for the country districts and the other for the towns-lest the whole of the scholarships should be monopolized by the most favoured districts. The opinion was also expressed that it might be sometimes desirable (as apparently would not be illegal under the Technical Instruction (Amendment) Act, 1801) to make scholarships tenable at certain efficient private profit schools, where no public schools are available, although such schools are debarred from receiving direct assistance. Such a course, however, would have to be adopted with the utmost caution.

Finally, the Conference considered the relations of the County Councils to the Technical Association, and a unanimous opinion was expressed in favour of a closer connection, while a suggestion was thrown out for the establishment of a quarterly journal registering the progress made in the various counties, a proposal which we are glad to hear is receiving the careful consideration of the Association.

Altogether, the discussion was felt to be of considerable value to those who have the practical work of organization in hand. We hope that such a Conference will be held annually, even if not more often, for in the novel work which lies before the County Councils points of difficulty will continually occur, on which consultation will be most useful. By the way, why should not the organizing secretaries form a permanent Association, on the model of the two Associations of Head Masters?

THE EVOLUTION OF ANIMALS. L'Évolution des Formes Animales, avant l'Apparition de l'Homme. By F. Priem 384 pages. Illustrated (Paris : Bailhère et Flls, 1891)

I N this addition to the series of volumes known as the "Bibliothèque Scientifique Contemporaine," we have a worthy companion to Prof. Gaudry's "Les Ancêtres de Nos Animaux," published three years ago. To some extent, indeed, the ground is covered by M. Gaudry's more ambitious "Les Enchaînements du Monde Animal," but since the latter is in three volumes, the present work ought to find numerous readers who might be repelled by the length of the other. Moreover, the work before us has the advantage of treating each group of animals throughout geological time in consecutive form, whereas in the "Enchaînements" the Palasozoic Invertebrates are described in one volume, and those of the Secondary period in another, while the Tertiary forms are not recorded at all Again, our author enters much more fully into the probable origin of one group from another than is the case in Gaudry's work. It is true, indeed, that in most cases these views are not original, but since they are generally taken from the highest authorities on the several groups, they will commend themselves the more strongly to students In most works on paleontology

NO. 1133, VOL. 44]

too little attention is, in our opinion, generally given to the evolution of the various groups of the Invertebrata from one another, and we can, therefore, give a hearty welcome to a volume like the present which is mainly devoted to this fascinating subject.

We need hardly say that Prof Priem is an out-and-out evolutionist: and we trust that we shall not disparage his work by observing that in some cases-apparently carried away by the very natural desire to make the most of his subject-he appears to have gone rather too far, stating as facts what are at best but probable hypotheses. For instance, we find it definitely stated on p 273 that the Stegocephalous (Labyrinthodont) Amphibians had a functional parietal eye, whereas there is, of course, no actual proof that this was the case

The work is rendered attractive by the large number of woodcuts with which it is illustrated. We regret. however, that in some cases-and more especially among the Vertebrates-the execution of these figures is by no means satisfactory. Moreover, in the chapters devoted to the Vertebrates (some of which are the weakest portions of the work) there are figures which are not only bad, but are utterly untrue to nature. Thus on p 266 the old figure of Coccosteus, with the maxillary bone doing duty for the mandible, once more reappears, while on p. 301 we have the reproduction of Goldfuss's erroneous restoration of Pterodactvius crasscrostres, which is unfortunately given as an illustration of the short-tailed genus Pterodactylus, whereas that particular species belongs to the long-tailed genus Scaphognathus.

We notice that in many instances M Priem gives his authority for his statements as to the phylogeny of particular groups, whereas in other cases such references are omitted. This is to be regretted, since it is often somewhat difficult to find out whether the author is promulgating his own views, or quoting those of others

The volume commences with an introductory chapter on paleontological evolution, in which the phylogeny of the horse, and the well-known passage of Paludina neumayri into P harness are instanced as the best examples we have of the derivation of one form from another. Following this chapter, we have the various groups of animals treated in detail, commencing from the lowest In the main the classification adopted is fairly well up to date, although we shall note some instances where the author departs from the more usual modern arrangements

For example, in treating of the classification of the Sponges on p 36, the author disregards Prof Sollas's separation of the Calcareous Sponges (Calcispongue) as a group of equal value with all the others (Plethospongia), so that we find the Soft, Horny, Flinty, and Calcareous Sponges ranked as equivalent groups Again, in the Coelenterates (or, as we prefer to call them, Zoophytes), the Palæozoic Corals are still classed under the primary divisions of Tabulata and Rugosa; the former group including such different forms as Favorites (belonging to the Zoanthana) and Heliolites, Halysites and Chatetes (usually referred to the Alcyonaria). Later on, however, pp. 62-64, the author recognizes Heliolites and its allies as the ancestors of the modern coral-like Alcyonarians, such as the Organ-pipe Coral (Tubipora), and we therefore fail to see his reasons for adopting the antiquated classification.

Some of the most interesting chapters in the volume are those devoted to the evolution of the Echinoderms, the author adopting Neumayr's view that the Palæozoic Blastoids, as well as Crinoids, Sea-Urchins, and Starfishes, are all separate branches springing from the Cystoids of the Palæozoic. The figures illustrating the gradual specialization of the Sea-urchins from the old Palæoechinoids, with their numerous rows of interambulacral plates, through the Triassic Trarechinus, and thence to the Neocomian Tetracidaris, with its two rows of anical interambulacrais splitting into four near its equator, and thence to the modern "regular" Urchins. strike us as particularly well selected. Equally instructive is the transition from the "regular" modern Urckins (Neoechinoids) to the "irregular" forms-at first with the retention of the masticating apparatus, and subsequently with its loss

Merely noticing that full justice is done to Neumayr's views regarding the phylogeny of the Brachiopods, we pass to the Mollusca, which we find treated in considerable detail and well illustrated. The author adopts the modern view of separating Dentalium as a distinct order (Scaphopods) from the Gastropods, and considers that both Pelecypods (Bivalves) and Scaphopods are derived from the latter. Nothing is said as to the origin of the Gastropods themselves, or, indeed, of the Cephalopodsprobably for the very sufficient reason that nothing definite is yet known. In regard to the mutual relations of the various groups of Cephalopods, the author comes to the conclusion that the Ammonites should form a distinct order, "Ammonoldea," to be placed between the Tetrabranchiates (Nautilus) and Dibranchiates (Cuttlefish) Since, however, he adopts the view that their shells were really external, and that they are probably descended from Nautiloids, there seems but little necessity for this third order. The gradual increasing complexity in the sutures as we pass from Goniatites to Ceratites, and from the latter to true Ammonites, is held sufficient to prove the descent of the latter from the former : while Goniatites are considered to be the direct offshoots from Nauriloids. which are themselves derived from straight forms like Orthoceras. It would require too much space to enter on the consideration of the relations of the various general of Ammonites to one another; but we may mention that the author fully adopts the modern views, such as the evolution of the keeled Amaltheus of the Jurassic from Ptychites of the Trias, and also that the uncoiled forms (Hamstes, Scaphstes, &c.) have had several distinct points of origin from true Ammonites And here we may take the opportunity of mentioning that the terms Ægoceras and Hatloceras applied to genera of Ammonites, are preoccupied by two well-known genera of Mammals, and therefore require changing. In regard to the Dibranchiate Cephalopods, it is considered that Belemnites have been derived from forms allied to Goniatites, and have themselves given origin to the modern Cuttle-fish. If this be the true phylogeny of the Cephalopods, it indicates a gradual increase in the complexity of the shell of the Tetrabranchiates, till it attained its maximum in the jurassic and Cretaceous. Then the total disappearance

NO. 1133, VOL. 44]

of all the external-shelled forms with the exception of the Nautius, while at the same time the Dibranchiates were gradually tending to develop less and less complex internal shells, till these culminated in the simple "pens" and "bones" of the modern cuttles and squids.

Coming to that portion of the work devoted to the Vertebrates, we find, as a irready mentioned, that the author has been in some places less successful than in the earlier chapters. We have already alluded to the misleading nature of one of the figures in the chapter on fishes, and we have to add that several of the few others with which that chapter is illustrated are highly unsatisfactory. It is probable, indeed, that the author had no opportunity of seeing the second volume of the "British Museum Catalogue of Fossi Fishes" before passing his proofs, as otherwise he would doubtless have modified

In his remarks on the difficulty of distinguishing between Dipnoid and Ganoid fishes (p. 265), the author seems to be totally unaware of the difference between the "autostylic" skulls of the former and the "hyostylic" of the latter, and when, on p 267, he states that the Dipnoids are a lateral branch of the Crossopterygian Ganoids. he is directly at issue with the writer of the Museum Catalogue, who states (p xx) that, "concerning the evolution of the Dipnoi, palæontology as yet affords no information " Again, although Prof Cope's observations as to the primitive structure of Pteraspis and its allies are referred to, we doubt whether the suggestion that the opening on the dorsal side of the head-shield corresponds to the aperture of a parietal eye will commend itself to the students of ichthyology. The chapter on the Batrachians is all too short, and, bearing in mind their resemblance to the Dipnoids in the autostylic structure of the skull, it is scarcely safe to make the statement (p. 282) that they are derived directly from Ganoids.

From his treatment of reptiles we fear that the author has but a very faint conception of the nature of a Theriodont or a Dicynodont, or else he would surely have made more of their affinity to the Batrachians on the one hand, and to Mammals on the other, while he would have also omitted any reference to the purely adaptive resemblance existing between the skull of Udenodon and that of a turtle. M Priem might also have informed his readers that Dicynodonts are not confined to Africa. On the other hand, we are pleased to see that M. Priem rejects the heresy propounded by some of his countrymen, that Ichthyosaurs were derived primitively from marine reptiles, in favour of the more rational view of their near relationship to the Rhynchocephalians. In stating that the Plesiosaurs are likewise related to the Rhynchocephalians, the author is in accord with modern views, although he should also have referred to the many indications of affinity presented by these reptiles to the Chelonians. When, however, it is stated, on pp. 295, 296, that the latter were probably derived from the toothless Dicynodonts (Udenodon), the author at once proclaims his ignorance of some of the leading features of reptilian osteology. The statement on p. 297, that the gigantic Siwalik tortoise had a shell measuring four metres in length, leads us to wonder when this fiction will finally disappear from text-books. The author's treatment of the Pterodactyles and Dinosaurs calls for no separate mention, although we are led to wonder why the Crocodiles are so widely separated from these groups.

The whole chapter on birds is decidedly feeble; and we must certainly take exception to the statement that Hesperorms and Ichthyorms respectively connect Archaopleryz with the Ratitæ and Carinatæ.

Turning to the last chapters, on the Mammals, we find the author adopting the view that the Monotremes have had an origin totally separate from the other two subclasses. We then have a notice of the Secondary Mammals, in which we observe a lamentable lack of attention to recent work on their affinities, and also to the synonymy of the various genera. We also notice that the Jurassic Plagiaulax and its allies are still referred to the Diprotodont Marsupials (p. 327), so that on these points the author's evolutionary views are totally out of date Following the Marsumals, we have a very fair, although brief, account of the most recent conclusions on Mammalian phylogeny, which needs but few remarks notice, however, that the author adopts M. Boule's views as to the dual origin of the Canada, according to which the Foxes (Alopecoids) are considered to have originated from Cynodictis, while the Wolves, Jackals, and Dogs (Thoulds) trace their descent to Amphicyon To ourselves, indeed, it has always appeared difficult to understand how these two groups of Canada have become so much alike if they had this dual origin, and this difficulty is increased by the author's statement that those Thooids known as Cyon differ from the other members of that group in having originated from Cynodictis,

On p. 343 the author makes a slip in stating that the Hydracoidea are now represented only by a single genus. while later on he appears to be uncertain whether the Siwalik beds should be regarded as Upper Miocene (pp. 349, 350) or Upper Pliocene (p. 366). Again, we notice on p. 353 some want of acquaintance with the recent literature relating to the ancestry of the horse, Oroluppus being identified with Pholophus, whereas the latter is really the same as Hyracotherium, while the former is identical with Pachynolophus. We are in full accord with the author when he states, on p 361, that Chalico-therium (with which the supposed Edentate Macrothersum is now known to be identical) is an aberrant Ungulate, although we must be permitted to differ from him when he adds that it shows signs of affinity with the Edentates.

We must likewise take exception to the statement, on p. 370, that the Indian Nilgai is in any sense the progenitor of the Oxen, while the view expressed on the same page, that the Buffaloes, Bisons, and true Oxen have severally originated from three distinct groups of Antelopes, can be only regarded as another instance of the author's partiality for multiple phylogenies. Although M. Priem is careful not to commit himself to the view that the Cetaceans have been derived from the extinct Enaliosaurian reptiles, yet the prominence which he gives to the statement of that view may be taken as a sign that he has not thoroughly purged himself from that

Finally, although we have felt bound to call attention to a certain amount of imperfection in the later chapters, work before us to those readers who are desirous of obtaining in a compact form a summary of the evidence afforded by palæontology of the progressive evolution of animal forms R. LYDEKKER.

METALLURGY.

Lecons sur les Métaux Par Prof. Alfred Ditte (Paris Dunod, 1891)

Tratté pratique de Chimie Métallurgique. Par le Baron Hans Juptner von Jonstorff Translated from the German by M. Ernest Vlasto. (Paris: Gauthier-Villars, 1891)

THESE two volumes, recently published, are both of unusual interest The first, by Prof Ditte, who is well known to English readers by his "Exposé de quelques Propriétés générales des Corps," may be said to mark a new departure in teaching the chemistry of metals. He points out that the principles of thermochemistry do not merely enable reactions to be explained, but to be predicted, and, on the other hand, when two sets of reactions are simultaneously possible, the laws of dissociation render it possible to rigorously define the conditions of equilibrium which are established in the chemical "systems" under consideration. It is often possible, with the guidance afforded by these laws, to say, in the absence of direct experiment, why one reaction is impossible and another certain to occur, or why a certain reaction begins without difficulty, and is arrested at a definite stage; or why a reaction which takes place readily under certain conditions cannot be effected under others that do not appear to differ greatly from those which were favourable to it. As a pupil of Deville, the author might have been expected to develop, in a treatise such as this, the teaching of his great master, and he has admirably performed his task. The classification of the work is excellent, the metals being first considered collectively, and then in detail with numerous tables of the data and constants which are so frequently required by metallurgists.

The work begins with a very clear account of Berthelot's labours in mécanique chimique, special care being devoted to the description of the calorimetric investigations, and to the appliances adopted in these important researches.

It appears to be a great advance for us in this country to read a chemical treatise in which the thermal values of the equations are stated in calories, side by side with the formulæ, As the book is too long to review in detail, it may be well to indicate the nature of one section only, as showing the author's care and thoroughness in the selection and arrangement of the materials. Take, for instance, the few pages devoted to carbides. The author points out that carbon in uniting with metals sometimes gives rise to the formation of true compounds, and at others to solutions of carbon in the metal. He then describes the orange-vellow product obtained by the action of carbon on metallic copper, and passes to the association of carbon with nickel, which does not confer upon nickel the property of being hardened by rapid cooling. The definite carbides of manganese, as well as the indefinite associations of yet, as a whole, we can conscientiously recommend the carbon with iron and manganese, receive due attention, and the author proceeds to deal with the carbides of iron, and finally with the well-defined carbides of mobium and tantalium, which have respectively the formulæ

Nb₂C, and Ta₂C₂
A terse description is then given of the work of Troost
and Hautefeuille on the heat of formation of carbides of
iron and manganese, which led to the conclusion that the
union of carbon and iron is attended with absorption of
heat while in the case of the union of carbon and man

bellow the Crown and row is attenued with absorption of the case of the union of carbon and maniganese heat is evolved, the evidence leading to the belief that Mhg.C is a true compound possessing considerable stability. The action of heat on carbodes is then dealt with, and a brief, but sufficient, reference is made to Forquignon's work on the action at a high temperature of hydrogen on cast-iron. The section concludes with a description of the modes of preparing carbodes, and with a sketch of the formation and properties of the nitrocarbides, more especially those of niobium and titanium.

The sections of the work devoted to the consideration of tellurides, areendees, and antimonides, are equally good. With regard to individual metals, in the portions of the work as yet published, only potassum, rubidium, cesium, ammonium, thallium, sodium, lithium and the metals of the alkaline earths, barium, strontium, and calcium are dealt with, but sufficient evidence of the ments of the book has been given in this brief review to show that the rest of it will be gladly welcomed, for Prof. Ditte has earned his place among the great metallurgists of France.

We should be grateful for curves indicating the effect of definite elements on the physical constants of metals.

Baron Jonstorff's book is of an entirely different character, though it in one, in its way, less excellent or useful. He says that it issues from an ironworks, and is addressed to practical metallurgists. Its aim is, however, somewhat different from that of most treatises on analytical chemistry, the author's intention being not merely to grade the chemist in his analytical methods; but to enable a blast-furnace manager or an iron-master to realize what kind of services the laboratory can render, what questions relating to the routine of work the analyst can solve, and, above all, in what way the questions should be and.

The author deals with the more important special methods of analysis, and of assaying iron and steel, and he gives due attention to the examination of refractory materials—slags, fuel, and gaseous products—and his method is singularly clear and precise. An appendix gives tabular statements which will be useful in daily work.

The book, as a whole, shows incidentally the great difference between the work-aboratory of the present day and that of twenty years ago. There is still much ironworks has, in many cases, cased to be little better than a shed, erected, say, behind the boiler-house, with an analyst and a few boys as the scentific staff.

Those who have visited the author in his beautifully stuated Syrian works, and have seen his manipulation, as the reviewer has, will appreciate the excellence of his labours, and will be glad that a good translation into French will make their results more generally known.

W. C. ROBERTS-AUSTEN.

NO. 1133, VOL. 44]

BACTERIA AND THEIR PRODUCTS.

Bacteria and their Products. By Sims Woodhead, M.D.
Published in the "Contemporary Science Series."
(London, Walter Scott, 1801)

SCARCELY a year passes in England, France, or in Germany, without the publication of one or more treatises on the fascinating subject of bacteriology. Many of the more recent of these works have been written for the general reader rather than for the student, and have shown a considerable want of accuracy and lucidity, a circumstance which can only be accounted for by the fact that accomplished bacteriologists have not been their authors.

We have now before us "Bacteria and their Producta," a work which we might infer from a glance at the cover, and general arrangement, to be certainly intended for the general reader. This wew is strengthened by the several object-lessons and homely similes scattered throughout the text, with the fitness of which we totally disagree; untess, for example, the extraordinary comparison of a nodule of Actinomyces with two datay heads placed base to base, "the sterile flowers in the centre" then corresponding to the club-shaped rays. The comparison is bad, but the botany is worse. Then there is the not very abstruse mathematical problem on p 24, and the guide-like description of the Pasteur Institute, all intended, we must conclude, for the general reader rather than for the student.

On the other hand, there is a very large collection of facts, much information about fermentation and chemistry (although the interesting and oft-quoted experients of Raulin are omitted), numerous references, and a very plentiful supply of formule, the whole requiring, in order to understand and appreciate them, a reader equipped with a thorough knowledge of the sciences bearing on the subject.

Putting this question aside, however, we candidly confess that we do not admire the style or arrangement of the book. There is a conspicuous want of lucidity, and of that accuracy of observation which one would have expected of the author For instance, "What are Bacteria?" is the question propounded in chapter ii. : but the answer to this key-stone question is left in much doubt, as the description of the protoplasm, cell membrane, mode of division and reproduction of the "specks," is exceedingly confused. We should not choose Gram's method to demonstrate the capsules of Actinomyces, nor, indeed, any other capsules, and we have reason to doubt, after the beautiful monograph on Cladothrix by Billet, that the brown colour of that organism is due to iron Again, what does the author mean when, speaking of cilia, he says, they "appear to develop only in those organisms that have special affinity for oxygen, for, as soon as the cultated forms reach the surface of a fluid. they lose their cilia or they become much less active." &c.? Tables of classification are heaped in with scarcely any attempt to sift and reduce them to a form compatible with the scope of the book. Is this done because, as the author says (p. 47), " to the pathologist, however, these classifications are of comparatively little value"? We maintain that for a work of this kind the author has no right to take a one-sided view, and that to the science of bacteriology the study of morphology is as important as any other side of the subject.

Turning to the description of actinomycosis and anthrax, we are surprised to find McFadvean taken as the guide in the former. Why is not the author his own guide? Or why does he not, at least, use the recent results of Boström? Then in "anthrax" it is stated "that at the point of inoculation in animals there is usually no evidence at all that it has been the point of entrance of the bacilli " This is scarcely compatible with a thorough knowledge of this familiar organism

Again, in the opening chapter, a number of bacteriologists' names are mentioned. We think the author hardly does justice to those of our own country, for amongst the four names placed by the author in honourable association with the great name of Sir Joseph Lister, neither Lankester, nor Tyndall, nor Lawes and Gilbert, nor Wooldridge, nor Lingard, finds a place And yet not only are these amongst our highest authorities, but the observations of Lankester and the experiments of Wooldridge constitute cardinal points in the history of bacteriology.

Lastly, the question of illustrations is a difficult one There are very many photographic processes to choose from, and considering that there are only 20 illustrations. the author might have employed collotypes (compare Frankel's atlas) or copper blocks, or, having used zinc blocks, should have had them printed on separate sheets, for it ought to be more generally known that it is of no use expecting a good impression from blocks of this description when printed on ordinary paper and in the text

OUR BOOK SHELF

Our Country's Flowers By W. J Gordon. (London Day and Son, 1891)

THIS volume is intended to aid beginners to ascertain the botanical name of any British wild flower or fern with which they may meet. After a list of local English plantnames, the serious work of the book begins with an explanation of how plants are classified, interwoven with which are a sufficient number of the terms used in describing plants to make the book "not too technical, but just technical enough" for the reader who desires to have a "nodding acquaintance" with the wild flowers of his own country This is given first in a chatty style, and then repeated in a convenent tabular form Next, the essential characters of the natural orders are given, after which the buttercup order, or Ranunculacere, is treated of at some length as a pattern of how identifications can be made. This is followed by a glossary of botanical terms, in some of which, in attempting a condensed and popular style, the writer has somewhat distorted the meaning. " Cambium " is erroneously described as a layer of mucilage, instead of a tissue. The characters of the natural orders are again stated, this time in alphabetical sequence, followed by a chapter on the genera, each of which is accompanied by a woodcut, intended to show its diagnostic character, but it is doubtful whether (at least in some of the orders) this is accomplished, as is also the case with some of the specific diagnoses with which the volume closes.

specific diagnoses with which the volume clovers.

In the 33 coloured plates 509 species are depicted. This crowding is unsatisfactory, and tends to obscure what might otherwise be very useful. The figure on plate 23, numbered 388, may possibly be intended for 508, the slinging-nettie, or 1t may be some abnormal

state of the inflorescence of a grape-vine. Centranthus ruber (204) and Plantago lanceolata (346) are also wonderful specimens of those plants The ariist, apparently, is amongst those who do not regard colour (unless it be the quantity thereof) as of value in discriminating species. The volume will, nevertheless, be a pleasant and useful companion to many during a country holiday, and, with the author, we hope will lead on to deeper study

A Summary of the Darwinian Theory of the Origin of Species By Francis P Pascoe, F.L S, &c. (London. Taylor and Francis, 1801)

It is difficult to understand why the author of this pamphlet should think it worth while to remind his readers periodically that he is an opponent of Darwinism Some space was recently devoted in these columns to the consideration of a book on the same subject by Mr. Pascoe, and the present production is nothing more than an abstract of this work, delivered in the form of an address to the Western Microscopical Club We have no new facts nor arguments, there is the same lamentable display of misconception, and the author has simply strung together some sixteen pages of excerpts from the writings of Darwin and others, without any attempt at connected reasoning either for or against the Darwinian theory. The author's position is practically this; here is the whole animal kingdom, consisting of about 600,000 species, you must explain every detail of specific structure, down to the most insignificant, by the theory of natural selection, if you cannot do this, the theory is The whole of Mr. Pascoe's writings in conuntenable nection with Darwinism amount to this, and nothing more: be has reiterated this statement, if not literally, at any rate in spirit, on every available opportunity for the last twenty years. The present pamphlet will, let us hope, for the sake of the author's reputation, be the last declaration to the same effect, for there is surely nothing gained either by Darwinism or anti-Darwinism by squandering the systematic powers which he is known to possess in picking out scraps of sentences from the "Origin of Species," &c., and publishing these things "of shreds and patches" under grandiloquent and misleading titles

The Business of Travel. a Fifty Years' Record of Progress. By W Fraser Rae. (London: Thomas Cook and Son, 1891)

THIS year the well-known firm of Thomas Cook and Son celebrate their fiftieth anniversary, and Mr. Fraser Rae has taken the trouble to write the present work in order to mark the occasion. The firm, it seems, had very small beginnings. Its history may be said to date from the day when, in 1841, Mr. Thomas Cook, walking along a country road, suddenly reflected that a certain temperance meeting at Loughborough would probably be a ance meeting at Lougnorough would productly ex-brilliant success if a special excursion train could be run between that place and Leicester Apparently, no such thing as a special excursion train had ever before been heard of. The idea was carried out, and attracted so much attention that Mr. Cook-who was at that time a wood-turner-was often asked afterwards for advice in wood-turner—was onen aseen aiterwards to radice in the organizing of railway excursions; and by and by he devoted himself wholly to the task of developing "the business of travel." His son has been for many years the sole managing partner, but to the elder Mr. Cook belongs the credit of having conceived the system with which his name is now associated. To what vast proportions the system has grown everyone knows; but there are probably few who know much about the various stages through which it has advanced to its present position. Mr. Fraser Rae tells the story clearly and effectively, and most readers, when they have finished his narrative, will be disposed to agree with him in thinking

that the jubilee of a firm which has played so prominent a part is an event of interest in the social history of the a part is an event of interest in the social instory of the nineteenth century. Messrs. Cook, by their energy and enthusiasm, have given a powerful stimulus to the popular love of travel; and they may fairly claim that their establishment ranks to some extent among the mfluences which are tending to break down international prejudices.

248

IETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions ex-peried by his correspondent: Nather can he underlake to return, or to correspond with the vortiers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of annymous communications!

The Albert University.

I DESIRE to associate myself with Prof. Carey Foster and, to agent extent, with Prof. Ray Lankester in the sistements of the professional professional professional professional Present circumstances force me to do so as briefly as possible; but I should be the less satisfied to keep attogether silent be-cause I had something to do with the drafting of the "Aibert"

charter in 1887. charter in 1887.

For my part, that draft was never regarded as an effective solution of the problem of a University for London I thought of it only as a handy weapon for forcing the appointment of a Royal Commission, and for shaking the London University Senate out of its happiness in the steady increase of untaught candidates for degrees.

candidates for degrees.

A Commission was extorted; and it had the impartuality, at least, of generate R in tuning was short and hurred, yet it by the London Colleges, during suity years, to condemn the inflicency and self-sufficiency of the London University. That understand the london University is a comparable to the london University. That was not to be a long to the london University. That was not to be a long to the london University in the london University is not long to the london University and the london University is considered to the london University of the london University Sensite We know what followed. The London University Sensite was the london University Sensite when the london University Sensite was the london University Sensite when the london University Sensite was the london University Sensite when the london University Sensite was the london University of the lo

We know what followed. The London University Senate was allow, very allow, to more at all towards meeting the London Colleges. But at list it woke up, and then after a mee began real accommodation seemed to have been sittained between the Councils of the Colleges on the one hand and the University Senate on the other. Even when the Senate threater, yielding give these also a direct representation (in the Leeth of the Commission's instruction and without warming to the London Colleges), I was one of those who here were still willing to try the contraction of the Colleges of the Colleg

It looks now as if the "Albert University" were straight way to be upon us instead I will not inquire into the agencies that have brought this result into such near view Nor will I in your columns follow up my present and my late colleague's arguments against the prospective creation with others that seem to me of serious import. But I may be allowed to endorse emphatically what Prof. Lankester has said as to the

to endorse emphatically what Prof. Lankester has said as to the sheenee of sanction by the professoral body here to the "Albert" draft charter. And nothing could be more to the point than Prof. Tostler's observation that the "Albert" scheme has never been unbuilted to a meeting of the Governor. Prof. Lankester vi clearly right in contending that the whole question should now have been, or should still be, referred back the Commission. I must, however, as a Socr, remark spon has assumption that the Northern Universities are professorably the machineous lay influence of more graduates. The fact is, that, ever nace 1860, graduates, in "Greenel Council" and also by direct representation in the 'University Court," have not been without voice or influence, while, by the later reforms and been without voice or influence, while, by the later reforms of the professorable powers of general ansangement are largely diminished or even (as respects finance, &c.) NO. 11.23. VOI. Add

abolished. There were more reasons than evidently Prof. Lankester knows of for curtailing the old professoral supremsey in a locatiand. But it does not follow that in England, and more especially in London, there should not be a much franker recognition of professoral (that is, expert) knowledge of educational ends and means than appears in the "Albert" draft. G. CROOM ROBERTSON. charter.

University College, London

P.S.—Since these remarks were put in print, a decision of the Pray Council has been announced in favour of an "Albert" (or "Metropolitan") University They lose, therefore, most of whatever interest they may have had; but they may still appear, to far as I am concreted, if the Editor pleases. I regart the decision, and think the promoters of it may yet have reason to with that their action had been less harract. At the same time, one may acknowledge the remarkable energy and fertility of resource with which the enterprise has been conducted to its thus far successful issue.—G. C. R.

It I may be allowed another word on this subject, I should like to say that, having been all along a keen advocate of the establishing of a strong professorial University in London, not necessarily in alaysh imitation of the German system (of which I happen to know something), but combining the main features of its professoriate (of which I think I abnowd my appreciation in a paper read at Bath in 1888, before Section B of the British in a paper read at Bath in 1888, before Section B of the British Association) with the essential elements of the present University of London, and believing that the draft charter of the Senate, which was presented to Convocation, contained in it the poten-

tighttes, out of which (with the exercise of a little common-sens tialities, out of which (with the exercise of a little common-sense to soften down such asperties as might cause friction in its initiatory working, together with a little patience to allow for the time necessary in all evolutionary changes) a strong professorial University could be developed, I woted for the Senate's scheme, and still think the adverse vote of Convocation ti greatest disaster that has befallen the University in the half-century of its existence

Of all the bitter things said by Prof. Lankester in his former

Of all the bitter things said by Prol. Lankester in his former letter, nothing was more to the point than his sarcastic challenge to the existing University to reform itself, if it can, with the "dead weight of graduates tied round its neck, and called Convocation." But must an institution, which has admittedly Convecation." But must an institution, which has admittedly done so much food, he swamped because of the accident of a food so much good, he swamped because of the accident of a stone from its neck? If anything can exceed one's admiration for Froil Lankesser's candoor in penning the letter, which appears in NATUEE this week! (July p. 922), it is the speak of the penning the letter, which appears in NATUEE this week! (July p. 922), it is likely appears in NATUEE this week! (July p. 922), it is likely appears in NATUEE this week! (July p. 922), it is likely appears in NATUEE this week! (July p. 922), it is likely appeared to the penning Commission, and that the Commissioners will give such advice to the "powers that be," that the shortsighted decision of to the "powers that be," that the shortughted decision of Convocation may be overruled, a For I ankeater has suggested twice over, and that (to use the words poken to me, the case acidemical expension so one could challenge) "the Government will take up the matter, and pass an Act doing what monume, ansated observations of the convocation of the convoca

Prof. Karl Pearson's idea of the "fusion" of the two Colleges (see NATURS, June 4, p. 103), as dutinit from "federation," is splendld in theory; but will it work? Can the fluxing material be found, which shall make the rion and the clay inter-fuse without either Gower Street or Somernet House, or both, sacrificing those traditions which are the strongest element in that individuality which each values to highly and both seems to anxious to conserve?

Wellington College, July 10.

Name for Resonance,

Al-Hottott inadvisuals as rule to correct errors in a report for which one in not responsible, there is one little missake on no 238 thus week, which uncorrected, may lead to the extinction of a useful suggestion.

In discussing the subject of "electric resonance" recently at Cambridge, I found that the term conveyed no correct meaning.

to the untechnically instructed. Its natural meaning implies echo or reverberation, and has a definite relation to sound Now, although a sort of reverberation or repetition in part of the effect intended to be denoted by the phrase resonance, yet the most seasonial feature of that phenomenon, and the one most is be emphasized in the recent extensions of the term, viz the accord of frequency or similar tuning between two vibrators, is not connoted at all. Hence, even in acoustics the term is hardly satisfactory, while its extension to other departments of physics may be misleading.

may or misseasing.

It was suggested, however, by Dr. Arthur Myers, that the existing word everower has almost exactly the right connotation, and has no special limitation to sound; while the derivatives syntony, syntonic, and syntonise may readily become English

systemy, systemic, and systemic may readily occure English without excling repulsion. The adjective "symphonic," suggested by the reporter of the Physical Society, does not strike me as 20 good, because it specially refers to sound again, and because the word "sym-phony" has already another definite meaning July 10. OLIVER L. LODGE.

Force and Determinism.

I no not think there are many non physicists who will attempt to gainsay the fact that, under physical constraint, the direction of motion may be determined without affecting the quantity of motion of the determined without affecting the quantity of This is seen when the earth and sun revolve around their common centre of gravity, or when I towit my stock around my finger and thumb, the earth and sun in the one case, and the ferrile and knot of my stick in the other case, being bound into one system physically. But I do think that an able and clear headed physical like Dr Oliver Lodge would be doing a clear beaded physicant like Dr Oliver Lodge would be doing a great service to non-physicate if he would, in your widely-nical language, the difficulties which trouble some of them, aiding them, for example, to comprehend the exact force of the words expenditure of energy, and helping them to see that in all known ease of change of direction of motion such change is all known eases of change of direction of motion such change is effected under physical constraint. It is when they are told by a certain class of metaphysicans, who quote, or misquote, physica in support of their assumptions, that physical motion is controlled by will-power or volition, always acting at right angles to direction of motion, and therefore leaving the amount of energy unchanged, it is Alen, I say, that they begin to grow restive, and to demand definite and vertifiable evidence that reture, and to demand definite and vertilative evidence that such metaphysical constraints it faire Sir John Henschel) a necessary or philosophical conception, and that it is impossible to explain the phonomena without having recourse to ir If Dr. Lodge would consent to help non-physicatis in this way, and would indicate what are the "important psychological consequences" to which he alludes, he would he doing some of us a good turn. C. L. LOVD MOKAM a good turn. University College, Bristol

As Prof. Lodge says he is glad to see that his statement, AS 1701. Longe says ne is guad to see that ms naturemen, "although expenditure of neargy in needed to increase the speed of matter none is required to alter its direction," called in ques-tion, and as he has so kindly answered one letter on the subject, may I ask him to criticise the following remarks?

The theory of kinematics is based on certain geometrical con-

cepts, which may be summed up in the term space, and on the concept of time The laws of motion, together with the assertion that mass is not a function of space or time, may logically be regarded as implicitly defining mass and force. Energy may similarly be defined, in terms of these kinematic concepts, as The For I think the progress of science is tending to show that the term "potential energy" is only a cloak to cover our ignorance of the kinetic energies which for the moment have gnorance or new nieut energies which for the moment has considered the statement quoted is logically only a truism, deduced from the definitions of interms, and is therefore indisputable in all mechanical theorems. But if it is to be applied outside the sphere of pure mechanics, the moral will be in the application of it—that as, it will be necessary to examine, before applying it to any new subject-matter, whether the definitions from which it was deduced apply to that subject-matter or not,

to tank subject-matter or not.

For example, by the third law of motion, mechanical force only acts between two masses, the momenta generated in them being equal and opposite. If, therefore, psychic force is to

come under the definition of mechanical force, it can only act between two particles. And, therefore, if psychic force is to do no work, by reason of its always acting in a direction normal to the path of a particle, it can only act between two particles whose paths happen to have a common normal-an occurrence which must be infinitely rare 12 Barkston Manssons, South Kensington, July 4.

Magnetic Anomalies,

THE discovery of very strong magnetic anomalies between Charkov and Kursk in Russia, to which A de Tillo has lately referred in the Comptes rendus and in NATURE, raises the question whether the values there observed are strictly local or extend over a relatively wide area. Thus, it would be of or extend over a relatively wide area. Ints, it would be of great interest to know if, on moving, say, some metres away from a station, the declination and inclination hold the same value. If not, there is clearly some cause which acts at a short distance, but if constancy is observed, a great step would be taken towards the settlement of the question as to the existence of strong variations common to a wide area

or strong variations common to a wice area. When magnetic anomalies are observed, the first thing to be done is to ascertain whether the values found in a given locality have a definite meaning—that is, whether they do not change for slight displacements, otherwise, the determination of the magnetic elements has no meaning, as it is impossible to refer magnetic elements has no meaning, as it is impossible to refer them to geographical co ordinates

The overlooking of this precaution has often led to serious istakes.

Alfonso Sella, mistakes. Biella, July 4.

Physical Religion.

As a constant reader of NATURE from its commencement, and the possessor of its forty three and a half volumes, I venture (after reading the review of "I'hysical Religion" in this week's number) to ask if it is intended to develop it into a theological journal Because, however smart it may be to abolish Abraham without "even taking the trouble to discuss" him, or to dispose of Lux Munds in a contemptuous sentence, it is hardly in

of Lux Minute in a contemptuous sentence, it is narray in accordance with scientific methods. It is curious that many "Agnostics," though by their own showing (if they would talk Latin instead of Greek) they are Lewisimises at best, should be so certainly sure of everything. when a little reflection and modesty might satisfy them that as "Know nothings" (in plain English) they have no more right to

deny than to assert

The standing motto of your title might be improved by the addition of "Ne supra crepidam sutor" Hompstead Heath, July 11 B WOODD SMITH

SOME APPLICATIONS OF PHOTOGRAPHY!

ONE of the subjects to which I propose to invite your attention this evening is the application of instantaneous photography to the illustration of certain mechanical phenomena which pass so quickly as to elude ordinary means of observation The expression "instantaneous photography" is perhaps not quite a defensible one, because no photography can be really instantaneous
—some time must always be occupied One of the simplest and most commonly used methods of obtaining very short exposures is by the use of movable shutters, for which purpose many ingenious mechanical devices have been invented. About two years ago we had a lecture from Prof. Muybridge, in which he showed us the application of this method—and a remarkably interesting application it was-to the examination of the various positions assumed by a horse in his several gaits Other means, however, may be employed to the same end, and one of them depends upon the production of an instantaneous light. It will obviously come to the same thing whether the light to which we expose the plates be instantaneous, or whether by a mechanical device we allow the plate to be submitted to a continuous light for

' Friday Evening Discourse, delivered at the Royal Institution of Gree Britain, on February 6, 1891, by Lord Rayleigh, FRS, Professor of Natural Philosophy, RI

only a very short time. A good deal of use has been made in this way of what is known as the magnesium flash light. A cloud of magnessum powder is ignited, and blazes up quickly with a bright light of very short duration. Now I want to compare that mode of illumination with another, in order to be able to judge of the relative degree of instantaneity, if 1 may use such an expression, We will illumine for a short time a revolving disk, composed of black and white sectors, and the result will depend upon how quick the motion is as compared with the duration of the light. If the light could be truly instantaneous, it would of necessity show the disk apparently stationary I believe that the duration of this light is variously estimated at from one-tenth to one-fiftieth of a second; and as the arrangement that I have here is one of the slowest, we may assume that the time occupied will be about a tenth of a second I will say the words one, two, three, and at the word three Mr Gordon will project the powder into the flame of a spirit lamp, and the flash will be produced. Please give your attention to the disk, for the question is whether the present uniform grey will be displaced by a perception of the individual black and white sectors [Experiment] You see the flash was not instantaneous enough to resolve the grey into its components.

I want now to contrast with that mode of illumination one obtained by means of an electric spark. We have here an arrangement by which we can charge Leyden sufficient, a spark will pass inside a lantern, and the light proceeding from it will be condensed and throw upon the same revolving disk as before. The test will be very much more severe; but, severe as it is, it think we shall find that the electric flash will bear it. The teeth on the outside of the disk are very numerous, and we will make them revolve as fast as we can, but we shall find that the electric flash will bear it. The teeth on the statemant of the statemant of

and the property of the property of the park because with a great a limit to the duration of the spark, because with a little care we could determine how fast the teeth are tragariant and the property of time. For this purpose it would not be safe to calculate from the multiplying gear on the assumption of no ship. A better way would be to direct a current of air upon the teeth themselves, and make them we have to a musical teeth themselves, and make them we have to a musical the disk under the spark we might safely say, I think, that the duration of the light is less than a tenth of the time occupied by a single tooth in passing. But the spark is in reality much more instantaneous than can be proved by the means at present at our command. In order to determine its direction, it would be necessary to have redetermine the duration, it would be necessary to have redetermine to direction, the control of the matter to-night.

Experiments of this kind were made some twenty years ago by Prof. Rood, of New York, both on the duratique of the discharge of a Leyden jar, and also on that of lightning. Frof. Rood found that the result depended somewhat upon the circumstances of the case, the discharge that of a larger one. He proved that in certain cases the duration of the principal part of the light was as low as one twenty-five-millionib part of a second of time. That is a statement which probably conveys very little of its as the statement which probably conveys very little of its as most twenty-five-millionib part of a second of time. That is a statement which probably conveys very little of its as most twenty-five-millionib part of a second of survey and mights. I wenty five million seconds is nearly a year, see perment is about the same fraction of one second that one second is of a year. In many other cases the duration was somewhat greater; but in all his experiments

it was well under the one-millionth part of a second, In certain cases you may have mulpile sparks. I do not refer to the outlining discharges of which Prof. Lodge grew us so interesting an account last year; Prof. Road's multiple discharge was not of that character. It consisted of several detached overflows of his Leyden jar when charged by the Rhumkorff coil One number mentioned for the total duration was one six-thousandth part of a second; but the individual discharges had the decree of instantanenty of which I have stocker.

It is not a difficult matter to adapt the electrical spark to instantaneous photography. We will put the lantern into its proper position, excite the electric sparks within it, causing them to be condensed by the condenser of the lantern on to the photographic lens. We will then put the object in front of the lantern-condenser, remove the cap from the lens, expose the plate to the spark when it comes, and thus obtain an instantaneous view of whatever comes, and thus obtain an instruction view of whatever may be going on I propose to go through the opera-tion of taking such a photograph presently. I will not attempt any of the more difficult things of which I shall speak, but will take a comparatively easy subject—a stream of bubbles of gas passing up through a liquid. In order that you may see what this looks like when observed in the ordinary way, we have arranged it here for projection upon the screen [Experiment.] issues from the nozzle, and comes up in a stream, but so fast that you cannot fairly see the bubbles. If, however, we take an instantaneous picture, we shall find that the stream is decomposed into its constituent parts arrange the trough of liquid in front of the lantern which arrange the trough of indud in front of the lantern which contains the spark-making apparatus—[Experiment]— and we will expose a plate, though I hardly expect a good result in a lecture A photographer's lamp provides some yellow light to enable us to see when other light is excluded. There goes the spark; the plate is exposed, and the thing is done We will develop the plate, and see what it is good for ; and if it turns out fit to show. we will have it on the screen within the hour

In the meantime, we will project on the screen some sides taken in the same way and with the same subject. [Photograph shown.] That is an instantaneous photograph of a stream of bubbles You see that the bubbles form at the noztle from the very first moment, contrasting in that respect with the behaviour of jets of water projected into air (Fig. 1).



The latter is our next subject. This is the reservoir from which the water is supplied. It issues from a nozale of drawn-out glass, and at the moment of issue it consists of a cylindrical body of water. The cylindrical form is unstable, however, and the water rapidly breaks up into drops, which succeed one another so rapidly that they can hardly be detected by ordinary vision. But by

means of instantaneous photography the individual drops can be made evident 1 will first project the jet itself on the screen, in order that you may appreciate the subject which we shall see presently represented by photography. [Experiment] Along the first part of its length the jet of water is continuous After a certain point it breaks into drops, but you cannot see them because of their rapidity. If we act on the jet with a vibrating body, such as a tuning-fork, the breaking into drops occurs still earlier, the drops are more regular, and assume a curious periodic appearance, investigated by Savart. I have some photographs of jets of that nature Taken as described, they do not differ much in appearance from those obtained by Chichester Bell, and by Mr Boys We get what we may regard as simply shadows of the jet obtained by instantaneous illumination; so that these photographs show little more than the outlines of the subject They show a little more, on account of the lens-like action of the cylinder and of the drops Here we have an instantaneous view of a jet similar to the one we were looking at just now (Fig 2). This is the continuous part; it gradually ripples itself as it comes along; the ripples increase; then the contention becomes a kind of ligament connecting consecutive drops;



the ligament next gives way, and we have the individual drops completely formed. The small points of light are the result of the lens-like action of the drops (Other

instantaneous views also shown l

The pictures can usually be improved by diffusing somewhat the light of the spark with which they are taken. In front of the ordinary condensing lens of the magic lantern we slide not a penceensing, tens us time magic lantern we slide may be provided as a slightly oiled, and we then get better pictures she often more shading. [Photograph shown] I here is one owing more shading. [Photograph shown] I here is one done in that way, you would hardly be the control of a temor. looks more like mercury You will notice the long ligament trying to break up into drops on its own account, but not succeeding (Fig. 3)

There is another, with the ligament extremely pro-

longed. In this case it sometimes gathers itself into two drops (Fig 4). [A number of photographs showing slight variations

were exhibited]

The mechanical cause of this breaking into drops is, I need hardly remind you, the surface tension or capillary force of the liquid surface. The elongated cylinder is an unstable form, and tends to become alternately swollen and contracted. In speaking on this subject I have often been embarrassed for want of an appropriate word to describe the condition in question. But a few days ago, during a biological discussion, I found that there is a recognized, if not a very pleasant, word. The cylindrical jet may be said to become varicose, and the varicosity goes on increasing with time, until eventually it leads to absolute disruption.

There is another class of unstable jets presenting many points of analogy with the capillary ones, and yet in many respects quite distinct from them. I refer to the phenomena of sensitive flames. The flame, however, is not the essential part of the matter, but rather an in-dicator of what has happened. Any jet of fluid playing

into a stationary environment is sensitive, and the most convenient form for our present purpose is a jet of coloured in uncoloured water. In this case we shall use a solution of permanganate of potash playing into an atmosphere of other water containing acid and sulphate of iron, which exercises a decolourising effect on the permanganate, and so retards the general clouding up of the whole mass by accumulation of colour. [Experiment.] Mr. Gordon will release the clip, and shall get a jet of permanganate playing into the liquid. If everything were pefectly steady, we might see a line of purple liquid extending to the bottom of the trough; but in this theatre it is almost impossible to get anything steady The instability to which the jet is subject now manifests itself, and we get a breaking away into clouds something like smoke from chimneys. A heavy tuning-fork vibrating at ten to the second acts upon it with great advantage, and regularizes the disruption. A little more pressure will increase the instability, and the jet goes suddenly into confusion, although at first, near the nozzle, it is pretty regular

It may now be asked "What is the jet doing?" That

is just the question which the instantaneous method

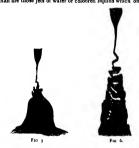


enables us to answer For this purpose the permanganate which we have used to make the jet visible is not of much service. It is too transparent to the photographic rays, and so it was replaced by bichromate of potash. Here the opposite difficulty arises, for the bichromate is invi-sible by the yellow light in which the adjustments have to be made I was eventually reduced to mixing the two materials together, the one serving to render the jet visible to the eye and the other to the photographic plate. Here is an instantaneous picture of such a jet as was before you a moment ago, only under the action of a regular vibrator It is sinuous, turning first in one direc-tion and then in the other The original cylinder, which is the natural form of the jet as it issues from the nozzle, curves itself gently as it passes along through the water. It thus becomes sinuous, and the amount of the sinuosity increases, until in some cases the consecutive folds come into collision with one another [Several photographs of sinuous jets were shown, two of which are reproduced in Figs. 5 and 6]
The comparison of the two classes of jets is of great

interest. There is an analogy as regards the instability, the vibrations caused by disturbance gradually increasing as the distance from the nozzle increases, but there is a

great difference as to the nature of the deviation from the great unterince as to me nature of the deviation from the equilibrium condition, and as to the kind of force best adapted to bring it about. The one gives way by becoming varicose; the other by becoming smuous The only forces capable of producing varicosity are symmetrical forces, which act alike all round. To produce simuosity, we want exactly the reverse—a force which acts upon the

iet transversely and unsymmetrically. I will now pass on to another subject for instantaneous photography—namely, the soap film. Everybody knows that if you blow a soap bubble it will break—generally before you wish. The process of breaking is exceedingly rapid, and difficult to trace by the unaded eye. If we can get a soap film on this ring, we will project it upon the screen and then break it before your eyes, so as to enable you to form your own impressions as to the rapidity of the operation. For some time it has been my ambition to photograph a soap bubble in the act of breaking. I was prepared for difficulty, believing that the time occupied was less than the twentieth of a second. But it turns out to be a good deal less even than that. Accordingly the subject is far more difficult to deal with than are those jets of water or coloured liquids which one



can photograph at any moment that the spark happens to

come
There is the film, seen by reflected light One of the first difficulties we have to contend with is that it is not easy to break the film exactly when we wish. We will easy to break the film exactly when we wish. We will drop a shot throught at The shot has gone through, as you see, but it has not broken the film, and when the syou see, but it has not broken the film, and when the any number of times from a moderate height without pro-ducing any effect. You would suppose that the skap in going through would necessarily make a hole, and end the life of the film. The shot goes through, however, without making a hole. The operation can be traced, not very well with a shot, but with a ball of cork stuck on the end of a pin, and pushed through. A dry shot does not readily break the film; and as it was necessary for our purpose to effect the rupture in a well-defined manner, here was a difficulty which we had to overcome. We found, after a few trials, that we could get over it by wetting the shot with alcohol.

We will try again with dry shot. Three shots have gone through and nothing has happened. Now we will try one wetted with alcohol, and I expect it will break the film at once. There ! it has gone !

The apparatus for executing the photography of a NO. 1133, VOL. 44]

breaking soap film will of necessity be more complicated than before, because we have to time the spark exactly than before, because we have to time the spark exactly with the breaking of the film. The device I have used is to drop two balls simultaneously, so that one should determine the spark and the other rupture the film. The most obvious plan was to hang iron balls to two electro-magnets, and cause them to drop by breaking the circuit, so that both were let go at the same moment. The method was not quite a success, however, because there was apt to be a little hesitation cess, however, because there was apt to be a little hesuation in letting go the balls. So we adopted another plan. The balls were not held by electro-magnetism, but by springs (Fig. 8) pressing laterally, and these were pulled off by electro-magnets. The proper moment for putting down the key and so liberating the balls, is indicated by the tap of the beam of an attracted disk electrometer as it strikes against the upper stop. One falling ball deter-mines the spark, by filling up most of the interval between two fixed ones submitted to the necessary electric pressure Another ball, or rather shot, wetted with alcohol, is let go at the same moment, and breaks the film on its passage through it. By varying the distances dropped through, the occurrence of one event may be adjusted relatively to the other. The spark which passes adjusted relatively to the other. The spark which passes to the falling ball is, however, not the one which illuminates the photographic plate. The latter occurs within the lantern, and forms part of a circuit in connection with the outer coatings of the Leyden jars, the



whole arrangement being similar to that adopted by Prof Lodge in his experiments upon alterna-tive paths of discharge. Fig 8 will give a general idea of the disposition of the apparatus. [Several photographs of breaking films were shown upon the screen; one of these is reproduced in Fig. 7.]2

This work proved more difficult than I had expected;

and the evidence of our photographs supplies the explanation-namely, that the rupture of the film is an extraordinarily rapid operation. It was found that the whole difference between being too early and too late was represented by a displacement of the falling ball through less than a diameter, viz. 1 inch nearly. The drop which we gave was about a foot. The speed of the ball would thus be about 100 inches per second; therefore the whole difference between being too soon and too late is represented by n_{00}^{+} second. Success is impossible, unless the spark can be got to occur within the limits of this short interval Prof. Dewar has directed my attention to the fact that

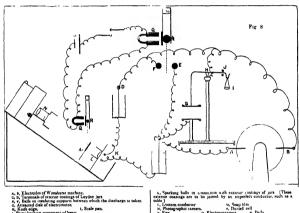
Dupré, a good many years ago, calculated the speed of rupture of a film. We know that the energy of the film is in proportion to its area. When a film is partially broken, some of the area is gone, and the corresponding potential energy is expended in generating the velocity of

In practice there were two sets of three jurs each The appearance of the breaking bobble, as seen under instantaneou unmanton, was first described by Marangonn and Stephanelli, Nese

the thickened edge, which bounds the still unbroken por-tion. The speed, then, at which the edge will go depends upon the thickness of the film. Dupré took a rather extreme case, and calculated a velocity of 32 metres per second. Here, with a greater thickness, our velocity was, perhaps, 16 yards a second, agreeing fairly well with

I now pass on to another subject with which I have lately been engaged—namely, the connection between aperture and the definition of optical images. It has long been known to astronomers and to those who study optics that the definition of an optical instrument is proportional to the aperture employed; but I do not think that the theory is as widely appreciated as it should be I do not know whether, in the presence of my colleague, I may venture to say that I fear the spectroscopists are

lenses may be. In accordance with the historical deve-lopment of the science of optics, the student is told that the lens collects the rays from one point to a focus at another; but when he has made further advance in the science he finds that this is not so. The truth is that we are in the habit of regarding this subject in a distorted manner. The difficulty is, not to explain why optical images are imperfect, no matter how good the lens employed, but rather how it is that they manage to be as good as they are. In reality the optical image of even a mathematical point has a considerable extension; light coming from one point cannot be concentrated into another point by any arrangement. There must be diffusion, and the reason is not hard to see in a general way. Consider what happens at the mathematical focus, where, if anywhere, the light should all be concentrated. At that point all the rays coming from the original radiant



among the worst sinners in this respect. They constantly speak of the dispersion of their instruments as if that by itself could give any idea of the power employed. You may have a spectroscope of any degree of dispersion, and yet of resolving power insufficient to separate even the D lines. What is the reason of this? Why is it that we cannot get as high a definition as we please with a limited aperture? Some people say that the reason why large telescopes are necessary is, because it is only by their means that we can get enough light. That may be in some cases a sufficient reason, but that it is inadequate in others will be apparent, if we consider the case of the sun. Here we do not want more light, but rather are anxious to get rid of a light already excessive. The principal raison d'Ure of large telescopes 18, that without a large aperture definition 18 bad, however perfect the

sction with exterior coatings of jars. [These joined by an imperfect conductor, such as a

o. Electro-magnets

point arrive in the same phase. The different paths of the rays are all rendered optically equal, the greater actual distance that some of them have to travel being compensated for in the case of those which come through the centre by an optical retardation due to the substitution of glass for air; so that all the rays arrive at the same time. If we take a point not quite at the mathematical focus but near it, it is obvious that there must be a good deal of light there also The only reason for any diminution at the second point lies in the discrepancies of phase which now occur, and these can only enter by degrees. Once grant that the image of a mathematical point is a diffused patch of light, and it follows that there must be a limit to definition The images of the com-

On this principle we may readily calculate the focal lengths of lenses without use of the law of sines (see Phri. Mag., December 1879).

NO. 1133, VOL. 44]

ponents of a close double point will overlap; and if the distance between the centres do not exceed the diameter of the representative patches of light, there can be no distinct resolution. Now their diameter varies inversely as the aperture; and thus the resolving power is directly as the aperture

My object to-night is to show you by actual examples that this is so I have prepared a series of photographs of a grating consisting of parallel copper wires separated by intervals equal to their own diameter, and such that the distance from centre to centre is 10 inch. The grating was backed by a paraffin lamp and large condensing lens; and the photographs were taken in the usual way, except that the lens employed was a telescopic object-glass, and was stopped by a screen perforated with a narrow adjustable slit, parallel to the wires 1 In each case the exposure auce sur, parallel to the wires. In each case the exposure was invertely as the aperture employed. The first [thrown upon the screen] is a picture done by an aperture of eight hundredths of an inch, and the definition is tolerably good. The next, with six hundredths, is rather worse. In the third case, if think that everyone can see that the definition is deteriorating; that was done by an aperture of four hundredths of an inch. The next is one aperture or four numeredins of an inch. I he next is one done by an aperture of three hundredths of an inch, and you can see that the lines are getting washed out. In focusing the plate for this photograph I saw that the lines had entirely disappeared, and I was surprised, on developing the plate, to find them still visible. That was in virtue of the shorter wave-length of the light operative in photography as compared with vision In the last example, the aperture was only two and a half hundredths of an inch, and the effect of the contraction has been to wash away the image altogether, although, so far as ordinary optical imperfections are concerned, the lens was acting more favourably with the smaller aperture than with the larger ones

This experiment may be easily made with very simple apparatus, and I have arranged that each one of my audience may be able to repeat it by means of the piece of gauze and perforated card which have been distributed The piece of gauze should be placed against the window so as to be backed by the sky, or in front of a lamp provided with a ground-glass or opal globe. You then look at the gauze through the pin-holes. Using the smaller hole, and gradually drawing back from the gauze, smaller note, and gradually drawing back from the gause, you will find that you lose definition and ultimately all sight of the wires. That will happen at a distance of about 44 feet from the gauze 1f, when looking through the smaller hole, you have just lost the wires, you shift the card so as to bring the larger hole into operation,

you will see the wires again perfectly

That is one side of the question However perfect your lens may be, you cannot get good definition if the aperture is too much restricted. On the other hand, if the aperture is much restricted, then the lens is of no use, and you will get as good an image without it as

I have not time to deal with this matter as I could wish, but I will illustrate it by projecting on the screen the image of a piece of gauze as formed by a narrow aperture parallel to one set of wires. There is no lens whatever between the gauze and the screen. [Experi-ment] There is the image—if we can dignify it by such a name-of the gaure as formed by an aperture which is a name—of the gaure as ionincia by an aperture is gradually narrowed, we will trace the effect upon the definition of the wires parallel to it. The definition is improving; and now it looks tolerably good. But I will go on, and you will see that the definition will get bad again. Now, the aperture has been further narrowed, and the lines are getting washed out. Again, a little more, and they are gone. Perhaps you may think that the explanation lies The distance between the grating and the telescope lens was 12 feet

In the faintness of the light. We cannot avoid the loss of light which accompanies the contraction of aperture but to prove that the result is not so to be explained, I will now put in a lens. This will bring the other set of wires into view, and prove that there was plenty of light to enable us to see the first set if the definition had been good enough. Too small an aperture, then, is as bad as one which is too large, and if the aperture is sufficiently small, the image is no worse without a lens than with one

What, then, is the best size of the aperture? That is remain stem, is the best size of the aperture? That is the important question in draling with pin-hole photography. It was first considered by Prof. Petrval, of Vienna, and he arrived at the result indicated by the formula, $2r^2 = f\lambda$, where 2r is the diameter of the aperture, A the wave-length of light, and f the focal length, or rather simply the distance between the aperture and the screen upon which the image is formed

His reasoning, however, though ingenious, is not sound, regarded as an attempt at an accurate solution of the question. In fact it is only lately that the mathematical problem of the diffraction of light by a circular hole has been sufficiently worked out to enable the question to be solved. The mathematician to whom we owe tion to be solved. The mathematician to whom we owe this achievement is Prof. Lommel. I have adapted his results to the problem of pin-hole photography [A series of curves (Philosophead Magazim, February 1891), were shown, exhibiting to the eye the distribution of illumination in the images obtainable with various apertures j The general conclusion is that the hole may advantageously be enlarged beyond that given by Petzval's

advantageously be enlarged beyond that given by Petrval's rule. A sutable radius sir = \(\sigma(1) \) with the own out on the procession of the procession was 0 07 inch, and the distance of the 12 × 10 plate from the aperture was 7 feet. The resulting picture of a group of cedars shows nearly as much detail as could be seen direct from the place in question

THE SMITHSONIAN ASTRO-PHYSICAL OBSERVATORY

THE Smithsonian Institution, as we have already announced, has established as one of its departments a Physical Observatory which, with the instru-ments, has been supplied from the Smithsonian Fund It occupies at present a temporary structure, though funds have been subscribed for a permanent building tunus nave open subscribed for a permanent building when Congress shall provide a suitable site. For the maintenance of the Observatory an appropriation has been made by Congress which became available on July 1. The actual instrumental work of the new Observatory will necessarily devolve largely upon a senior and a junior assistant, who can devote their entire time to research, and it is hoped that with the improved apparatus it will be possible to prosecute advantageously investigations in telluric and astro-physics, and particularly those with the bolometer in radiant

In accepting the position of assistant secretary of the Smithsonian Institution in 1887, Mr. Langley retained the Directorship of the Observatory at Allegheny for the purpose of completing the researches begun there, and after his appointment as Secretary of the Institution, he still continued the titular Directorship, though but a duties at the capital. With the completion of the equipment of the little Observatory at Washington, he, however, formally resigned, on April 30, the Directorship at Allegheny, which he had held since 1887; and he will, so far as his administrative occupations permit, give

vestigations.

The class of work which is referred to does not ordinarily involve the use of the telescope, and that which is contemplated is quite distinct from what is carried on at present at any other Observatory in the United States The work for which the older Government Observatories at Greenwich, Paris, Berlin, and Washington were founded, and in which they are now chiefly engaged, is the determination of relative positions of heavenly bodies, and our own place with reference to them. Within the past twenty years all these Governments, except that of the United States, have established astrophysical Observatories, as they are called, which are, as is well known, engaged in the study of the heavenly bodies as distinct from their positions-in determining, for instance, not where, but what, the sun is, how it affects terrestrial climate and life, and how it may best be studied for the purposes of the meteorologist, and for other uses of an immediately practical nature

The new Observatory is established for similar purposes. Its outfit includes a very large siderostat (recently completed by Grubb), which is mounted in such a way as to throw a beam of light horizontally in the meridian It is intended to carry a mirror of 20 inches diameter, and is perhaps the most massive and powerful instrument of its kind ever constructed. Within the dark room is mounted another large instrument—the spectrobolometer -which is, in effect, a large spectroscope with 20-inch circle reading to 5 seconds of arc, specially designed for use with the bolometer It was made by William Grunow and Son, of New York, as the outcome of Mr. Langley's experience with smaller apparatus during his earlier investigations. The most important part of the instrumental equipment is completed by specially designed galvanometers, scales, and a peculiar resistance box, and these three instruments, used in conjunction with the bolometer, and perhaps with the aid of photography, will be employed in the investigations upon light, heat, and radiant energy in general, for which the Observatory is primarily intended, though some departments of terrestrial physics may also receive attention

THE NEW GALLERY OF BRITISH ART.

WE believe that the Committee appointed by the Corporation to consider the question of the grant of a site on the Embankment for the new gallery will soon make its report. The Pall Mail Gazette of Tuesday says:—"There is a vacant piece of just one acre at Black-firars, on the land acquired some years ago and cleared of the old City gas-works by the Corporation. This land originally cost some £260,000, and on portions of it have been erected the City of London School and Sion College. The value of the entire holding has increased to at least £550,000; so that if the proposed piece, which is valued at about £120,000, were made over by the Corporation for the Art Gallery, the City would still be a gainer of some £170,000 by the transaction."

In the meantime, public opinion is rapidly growing, not only in favour of some of our national buildings devoted to art finding a home in the City, but also against the site at South Kensington—bought for scientific purposes, and required to meet existing needs-being diverted

from its proper and natural use

Both these views are expressed in the following
Memorial, which, although circulated chiefly among

men of science during the last few days, contains the names of many representative men in other branches It has been transmitted to the Lord Mayor during the present week.

Memorial to the Right Honourable the Lord Mayor of London

WF, the undersigned, having heard that there is a possibility of the City of London finding a site on the Embankment for the National Gallery of British Art, which a munificent donor has proposed to build, venture to approach Your Lordship with our earnest request that you will yourself support, and use your best endeavours to urge upon the City authorities, the very great importance of giving effect to this proposal.

The memorial already presented to the Prime Minister will have made Your Lordship aware of the many strong objections, from the scientific point of view, to the site which was suggested for the gallery in the first instance

It is innecessary for us, therefore, to say more on this subject, except to remark that the greatest city in the world must be the first to suffer if, from any cause, the proper presentation of science and means for its study by its citizens are in any way crippled

By affording a site on the Embankment, Your Lordship and the authorities you represent will be the means of preventing the lamentable result to which we have referred, and you and they will earn the gratitude of all interested in scientific progress, as well as confer a great boon on the art-loving public

Among the signatories of the Memorial are the following -

SIR WILLIAM THOMSON, D.C.L., LL.D., President Royal Society, Professor of Material Philosophy, Glasgow DR JOHN EVAN, I.L.D., F.R.S., Terasurer Royal Society LORD RAVLEIGH, F.R.S., Sceneriary Royal Society M. FOSTEN, M.D., F.R.S., Secretary Royal Society THOMAS II HUXLEY, F.R.S., Dean of the Royal College of Science, London Science, London

LIEUT GENERAL R. STRACHEY, F R.S., C I E., Chairman Meteorological Council. NRVII STORY MASKELYNE, F R S., M P., Professor of Mine-

ralogy, University of Oxford

Sir John Lubbock, Bart, M.P., F.R.S., Chairman London
County Council, Past-President British Association

SIR RICHARD QUAIN, Bart., M.D., F.R.S.
SIR WILLIAM ROBERTS, F.R.S., M.D.
WILLIAM CROOKES, F.R.S., President Institute Electrical Engineers

WILLIAM SUMMERS, M P
J. W. L. GIAISHER, M A, F R S
ALFRED NEWFON, F R S., Professor of Zoology, University

ALFRED NEWTON, F. R. S., LINESSON OF CAMPBINGS
T. E. THORFF, F. R. S., Professor of Chemistry, Royal College
of Science, Treasurer Chemical Society
JOHN W. JUDD, F.R. S., Professor of Geology, Royal College of Science

WILLIAM HUGGINS, D.C.L., F.R.S., President-Elect of the British Association

British Association.

G G STOKES, Bart , M P., Past-President Royal Society,
Lucasiae Professor, University of Cambridge
Sig Henry E Roscog, LL D , F R S , M P , Past-President

British Association.

WITHIS ASSOCIATION.

OF TLLS ADJUST, IT Pythol Society.

J. PLATCHER MOULTON, Q. C., F. R.S.

E. A. SCHAERER, F.R. S., Professor of Physiology, University College, London

IRBBERT MCLEON, F. R. S., Professor of Chemistry, Cooper's

Hill

- O. HENRICI, F.R.S., Professor of Mathematics, City and Guilds of London Institute.

 HENRY E. ARMSTRONG, F. R.S., Professor of Chemistry, City and Guilds of London Institute. Secretary Chemical
- Society R. B. CLIFTON, M.A., F R S., Professor of Natural Philosophy.
- University of Oxford.

 J. BURDON SANDERSON, F.R.S., Professor of Physiology. Oxford
- OXIOTO,
 WILLIAM ODLING, F.R.S., Professor of Chemistry, Oxford.
 WILLIAM ESSON, F.R.S., Oxford
 EDWARD B. POULTON, F.R.S., Oxford.
- E. RAY LANKESTER, F R S., Deputy Professor of Anatomy. Oxford.
- Oxford.

 G. CAREY F. R. S., Professor of Physics, University G. CAREY F. COMON, P. R. S., Professor of Physical Society, J. However, P. R. S., Wheatstone Professor of Electricity, King's College, London.

 CAPTAIN ABNEY, C. B., F.R. S.
 THE YERY REW G. G BRADLEY, D. D., C.B., Dean of West-
- minster.
- WILLIAM BLACK
- LEWIS MORRIS,
 W. H. M. CHRISTIE, F R S., Astronomer-Royal.
 WILLIAM MORRIS
- WALTER CRANE
- W. J RUSSELL, F R.S., Professor of Chemistry, St. Bartholomew's Hospital, Past-President Chemical Society. THE LORD TENNYSON, F R.S , Poet Laurente. HALLAM TENNYSON.

CARDINAL HAYNALD.

THE death of Cardinal Haynald, Archbishop of Kalocsa, is announced in the daily papers as having taken place on Saturday, the 4th inst It was not an unexpected event, as his health had been gradually getting worse for some two or three years Last year he celebrated the jubilee of his priesthood, and Dr. A Kanits, Professor of Botany in the University of Klausenburg, made it the occasion of publishing a eulogy on him as a botanist This was translated into French by Prof. E. Martens, of Louvain Although an excellent botanist, Cardinal Haynald was better known as a patron of botany than as a contributor to botanical literature For the following particulars of his life and work we are mainly indebted to Dr Kanitz's memoir

Cardinal Haynald was born about 1816 His taste for botany was inherited from his father, who himself possessed a fine herbarium During his stay at Vienna, in the Augustinaum, a theological college, he became acquainted with Edward Fenzl, then assistant curator of the botanical department of the Court, under whose tuition his botanical studies took a more practical shape priestly duties, however, did not allow him to follow his favourite study until he was appointed Bishop of Transylvania, when he began to investigate the flora of this vania, when he bogan to investigate the flora of this country with indefantgable zeal. He became Archbishop of Karthago, and afterwards of Kalocsa, and after the accession of Lee the Tenth to the Papal chair, a Cardinal. He was a long time a prominent member of the Hungarian House of Magnates, and from 1873 also a member of the Royal Hungarian Academy of Science Although always overburdened by the sacerdotal, political, and social duties of his high position, he found time to continue his botanical studies. He published only a few botanical papers, partly on Hungarian plants, and partly biographical sketches of botanists with whom he was more intimately acquainted, as Fenzl, Parlatore, and Boissier. His greatest merit, however, from a scientific point of view, was the assistance which he gave to botanical studies in Hungary by establishing a great private herbarium, which he placed in the most liberal way at anybody's disposal, and by the magnanimous generosity with which he

always supported botanical enterprise, both in Hungary and abroad. The herbarium at his residence gary and abroad. The herbarium at his resument at Kalocsa was not only the richest in Hungary, but one of the largest private collections on the Continent. It was largely formed by the purchase of the herbaria of Heuffel, Schott, Kotschy, and Sodiro Besides these and the plants collected by himself, he acquired most of the collections which have been distributed by subscription.

Hungary loses in Cardinal Haynald one of her greatest patriots, who was an honour to his profession, as well as to science, of which he was always a generous benefactor Schur named after him a genus of grasses, founded on Secale villosum, Linn., which is reduced by Bentham and Hooker to Agropyrum, and Kanitz a genus of Lobeliaceæ.

OXFORD SUMMER MEETING OF UNIVERSITY EXTENSION STUDENTS

THE process by which University Extension is carried throughout the country and made a vehicle for the further education of the adult student is well known, and is gradually becoming more and more appreciated in proportion as those who are responsible for the method improve the lines on which it is carried out. machinery employed embraces lectures, classes, travelling libraries, &c., but one element vitally necessary to the University student is not supplied by these aids. This element is that of residence, and it was a happy sugelement is that of residence, and it was a happy sug-gestion on the part of the originators to propose that, for one month in the Long Vacation, arrangements should be made by which those who have profited by being brought into contact with a University lecturer should enjoy the additional advantage of being brought under the charm that haunts the colleges and closters of Oxford and Cambridge

The Oxford summer meeting commences on July 31, and is continued throughout the month of August, but, for the benefit of students who are unable to be present during so long a period, the course is divided into two sections, the second commencing on August 12. It has been found desirable to remove as far as possible the fragmentary and isolated character of the lectures given at these meetings, and therefore, while the course will be complete and independent in itself, it will also form the first part of a cycle of study which for its full development

will embrace a period of four summers

That these lectures propose something more than to
add piquancy to an agreeable picnic will be shown from
the following slight sketch of the subjects treated—and treated by authorities of acknowledged reputation To take the lectures on natural science first in physiology, Mr Poulton will discuss the recent enticisms of Weismann's theory of heredity, and Mr Gotch will lecture on the functions of the heart. In chemistry, Prof. Odling lectures on the benzene ring, and under the supervision of Mr Marsh a course of practical chemistry will be conducted in the laboratory of the University Museum In geology, a course of practical instruction will be given by Prof Green and Mr. Badger, to include excursions in the neighbourhood of Oxford clude excursions in the neighbourhood of Voltoria A class in practical astionomy will be welcomed at the University Observatory; while electricity finds an able exponent in Mr. G. J. Burthe. But the distinguishing feature of this meeting is the attention given to agricultural science "designed for agricultural audiences under County Council schemes". This designation seems somewhat vague, and it will be very interesting to see the character of the audience attracted by this title. Four lectures are offered the first is entitled, "The application character of the audience attention of Aortculture." This description is sufficiently wide, but does not indicate whether the lecture is intended as a sample of those which State-aided Board

schools in agricultural districts might well offer to lade who have passed through the successive standards, or as one addressed to the sons of farmers, and supplying that form of instruction which it is the duty of agricultural colleges to impart. Another lecture is offered on the management of poultry. This is more definite and more hopeful; and when we remember that the students who come up for these summer meetings are, for the most part, ladies, who can well be supposed to take an intelligent interest in this part of farming operations, we must admit that the subject is well chosen. Manures of various admit that the subject in the other two lectures, and

will be doubtless of a sufficiently technical character. The literature and history lectures are of special interest, and by the combination of many lecturers are made to cover with great completeness the mediurval new orders of the conference of the control of the conference of th

THE PROPOSED TEACHING UNIVERSITY FOR LONDON.

ON Monday, at the Council Office in Downing Street the Universities Committee of the Privy Council, consisting of the Lord President of the Council (Viscount Crarbono), the Earl of Selborne, Lord Monk Birtton, Lord Basing, and Lord Sandford, reassembled for the purpose of giving their decision on the pettion of King's and University Colleges for the grant of a charter for the establishment of a Teaching University for London

The Earl of Selborne, in giving the opinion of their Lordships upon the draft charter of the proposed University, said, with regard to the opposition of the existing University of London, that some of the objections made might be treated as disallowed — It had been understood by their Lordships that a minimum course of two years' study at the new University would be required. It that was so, their Lordships were satisfied, and would say no more upon the point. The objections put forward by the medical faculty were generally disallowed. The word "London" would have to be omitted from the charter, but the University might be called either "the Albert University" or "the Metropolitan University." With regard to the suggestion that ten members of the Faculty of Medicine should be elected to the Council, their Lordships were of opinion that the medical schools should fill five places upon that body, or, if it were pre-ferred, that each school should elect one member for the Medical Board of Study. If the Royal Colleges and the medical schools agreed to come in together, however, the number of members on the Council might be raised. Their Lordships did not approve of the proposed strength of the Council, and thought that four of the places might be accorded to the Faculty of Law. Teachers in any branch of science, their Lordships considered, should be branch of science, their Lordships considered, should be admitted as members of the Science Faculty, and the six places on the Connoi which it was proposed to give the state of the Connoi which it was proposed to give soft paragraph of the Royal Commissioners' Report I if the medical schools and colleges declined to come in at first, provision ought to be made to allow them to do so in the future. Their Lordships thought that a place upon the Council might be given to the Apochecancer Society, but they were not disposed to insist upon that being done The view of their Lordships upon the question of honorary degrees was that no such degrees should be granted in medicine, and that the holding of an honorary

degree should be no qualification for election to the Council. The ordinary degree in medicine should not be granted until the whole of the prescribed conditions had been fulfilled.

NOTES

This decision of the Universities Committee of the Prity Council with regard to the proposed new University for London is one that might have been expected from a body of non-experts. It is hastly, and will give satisfaction to no one by whom the subject has been seriously considered. It may throw back the higher teaching in London for half a century.

Mr. WALTER BESANT, in an imaginary "Page from the Kauer's Dury," notes that there are not to be seen at Court any of "the people who make the real greatness of the country—this traders, its manufactures, it men of science, art, and literature." It has been remarked that in this respect the Guy Corporation, last Friday, followed the example of the Court, no representative of science, or literature, or art, as such, having been invited to the Guidhall banquet. It would have been better to follow the precedent set at the time of the Cara's visit when a large number of the leading scientific me were asked to the reception at the Foreign Office, and were personally presented

At the ensuing British Association meeting at Cardiff, it is proposed to hold in Section A, if possible in conjunction with Section C, a discussion on "Units and their Nomenclature," having special regard to the new electrical and magnetic units now becoming necessary for practical purpose.

This Secretary of State for India in Council has appointed, on the nomination of the Government of India, the following persons to represent it on the permanent governing body of the imperial Institute, for the year ending April 30, 1892 — W. T. Thiselton-Dyer, C. M.G., F. R. S., Director, Royal Gardeni, Kew, General James T. Walker, R. E., C. B. F. R. S., late Surveyor General of India, John W. P. Murc-Mackenin, Arrachitural Department of India Revenue and Arrachitural Department

SIR J. D. HOOKER has been elected a Foreign Member of the Academy of Sciences in Buda-Pesth.

THE Secretary of Sitte for the Colones has appointed, on the normalism of Kew, Mr C. A Barber, late Scholar of Christ's College, Cambridge, and University Demostrator in Busary, to be Superintendent of the recently created Agricultural Department of the Leeward Islands. The Superintendent will recide in Antiqua, and will have the general supervision of the botanness statistics at Antiqua, Dommies, Montserrat, and St. Kitts-News.

THE Council of University College, Liverpool, have appointed Mr Francis Gotch, of Oxford, to their new Chair_of Physiology.

THE Foreign Office has expressed the wish that the "Flora of Tropical Africa," prepared at Kew under the editorship of Prof. Oliver, and of which three volumes have appeared, should be continued and completed it is calculated that four more volumes will be required, and the Treasury has sanctioned a scheme by which the necessary funds will be provided.

THE Accademia dei Lances of Rome has awarded to Prof Saccardo, of Padus, in acknowledgment of his labours in mycology, the Royal prize of 10,000 francs intended for the encouragement of morphological researches. THE Government has appointed the Council of the Society of Arts as a Royal Commusion to direct the formation of the Bittath Section at the Chicago Exhibition. If we may ladge from the preparations which are being made in America, the Exhibition as likely to be one of great splendour One of its attractions will be a collection of objects relating to ethnology and archaelogy. This is being organized by Prof. Petanam.

A COMMITTEE, as we recently stated, has been appointed for be reorganization of the Natural History Museum as Paris. By some who interest themselves in the question it is proposed that the Museum should be made the only institution in Paris for the study of natural history. According to this scheme, all natural history cleans in the Sorbone and elsewher would be matural history proper would also disappear. The professors would have to examine all candidates in natural history proper would also disappear. The professors would have to examine all candidates in natural receive.

A COMMITTEE appointed by the Photographic Soldiny of Great Binata has presented a preport on the proposal that the photographic solcities of the United Kingdom should unter more closely for the better promotion of their common interests. The Committee advises that it should be open to photographic societies to sallitate themselves to the Photographic Society of Great Binatin , and suggestions are made as to the way in which stillation should be effected

TRE 5fth season of the Ednburgh Vacation Courses will begin on August 3. M. Espinas, Prefessor of Philosophy and Dean of the Faculty of Letters in the University of Bordeans, Passabe sha been charged by his Government to report upon the educational scheme and methods of these courses, and also teletres to tional scheme and methods of these courses, and also teletres to maquer into Southin higher education generally. Dr. H. de the Vangray, who will deliver a series of factures on general biology, who will deliver a series of factures on general biology. Extension movement. The expected presence of these and other the sales to the present passable that it might be well to hold, that Ednburgh, a small informal Congress, or rather a short series of meetings, for the discussion of currentle, higher educational methods, and other questions of immediate interest. Particulars on this subset will shortly be a announced.

THE Royal Society of Antiquaries of Ireland hold their general meeting in the Town Hall, Killarney, on August 11. Excursions are planned for every day, except Sunday, from August 11 to 20

THE Royal Archeological Institute will hold its annual meeting at Edinburgh from August 11 to 18 Sir Herbert Maxwell will preside

THE German Anthropological Society will hold its twentysecond annual meeting at Danzig, from August 3 to 5

HER MAJESTY'S Commissioners for the Exhibition of 1851, assisted by a committee of gentlemen experienced in acientific education, have made the following appointments to Science Scholarships for the year 1891. The scholars have been bondfide students of science for at least three years, and were nominated for the Scholarships by the authoritles of their respective Universities or Colleges. The Scholarships are of the value of £150 a year, and are tenable for two years (subject to a satisfactory report at the end of the first year) in any University at home or abroad, or ln some other institution to be approved of by the Commissioners. The scholars are to devote themselves exclusively to study and research in some branch of science the extension of which is important to the industries of the country. A Scholarship was offered to the University of Sydney, but the Council found themselves unable to nominate a suitable candidate. Nominating institution-University of Edinburgh, scholar-John Shields, institution to which scholar pro-

a Continental University, probably Leipzig; University of Glaagow, James H. Gray (a), University of Glaagow; University of St. Andrews, William Frew, Univer-sity of Munich, Mason Science College, Birmingham, John Joseph Sudborough, University of Heidelberg, University College, Bristol, Frederick Benjamin Fawcett (a), University College, Bristol; Durham College of Science, Newcastle-on-Tyne, William M'Connell, jun (a), Durham College of Science; Yorkshire College, Leeds, Harry Ingle, a German University, probably Wurzburg; University College, Liverpool, Robert Holt (a), University College, Liverpool : Owens College, Manchester, Thomas Ewan, Owens College, first year, University College, Nottingham, Edwin H Barton (b). South Kensington, Firth College, Sheffield, Annie J Hoyles (a), Firth College, Sheffield; University College of South Wales and Monmouthshire, Franke Herbert Parker, first year same College, second year a German University; Queen's College, Belfast, Benjamin Moore, University of Leipzig; Royal College of Science for Ireland, Frederick William Dunn, first year University of Glasgow, second year Berlin, M'Gill University, Montreal, Percy Norton Evans, University of Berlin, and probably other German Universities; University of Melbourne, William Huey Stecle (a), University of Melbourne, (a) These scholars have been recommended to spend part of the term of scholarship at some other institution (b) This appointment is conditional on the candidate passing examination for B.Sc London

Titoss who require power for electric lighting may be interested to know that Messra. Prestman Brothers have a good account to give of the success of their oil-engine. Many orders have been received for engines varying in sue from 1 to 25 actual hp. for electric lighting, and Messrs Prestman, in order to meet the growing demand, have largely extended their works

ACCORDING to a telegram sent through Reuter's Agency from San Francisco, July 11, an enormous cavern in Josephine County, Oregon, at a point twelve miles north of California and forty from the coast, has been discovered. It has two openings, and contains many passages of great beauty 'There are numbers of semi-transparent stalactites, several giant milk-white pillars, and a number of pools and streams of clear, cool water A week was spent in exploring the cavern, and innumerable passages and chambers were discovered. On penetrating one of these passages for a distance of several miles, the exploring party came across a lake of clear water and a waterfall thirty feet high All kinds of grotesque figures were found in the various chambers; but the only signs of animal life were discovered a short distance from the entrance, where a few bones were found, indicating that bears had carried their prey there. The cavern appears to be fully as large as the Mammoth Cave in Kentucky.

DR D PRAIN, Curator of the Calcutta Herbarium, has published an the Journal of the Assute Society of Rengal, and separately, a memor on new Indian Labatas. Nearly fifty speecks, belonging to upwards of twenty genera, are added to those described in the "Flores of British India." They are mostly from frontier extensions of the Empire, some from the east, some from the east, some from the west; and nearly half of the species are new to science. Specially interesting among these is Frait's new genus Microfesas, founded upon the Pitternsthus Pattlewist, new genus Microfesas, founded upon the Pitternsthus Assum. The first has since Calcutted and South-Eastern Calcutted and S

scholar—John Shields, institution to which scholar proposes to attach himself—University of Edinburgh and Prof. G. Bonnier, with the assistance of a number of botanists, will be published under the auspices of the Minister of Public Instruction of France

The annual publication of the very meful. "Correspondance totainque" ceased with the death of its editor, Prof. E. Morreo, of Lidge. With the aim of supplying its place, the International Library, 4 Rue de la Sorbonne, Parls, has now issued a "Nowelle Correspondance boatingue, liste des botanties de totas les pays, et des établissements, sociétés, et journanx de botanties."

PRINCE ROLAND BONAPARTE has issued, at his own expense, a handsome book on Corsica, recording his travels and the history of the island. He also gives a full bibliography relating to the subject,

A NEW quarterly scientific journal has made its first appearance in Parls, under the title Revue des Sciences naturelles de POuest, devoted to the interests of zoology, boiany, geology, mineralogy, anthropology, embryology, and teratology.

A MONTHLY journal of natural science, which may have many opportunities of doing good work, has just been started in Malia. It is called *The Mediterr anean Naturalist*, and is edited by Mr. John H. Cooke, F.G. S.

THE "Dictionnaire d'Agriculture," by J A Barral and H. Sagnier, will soon be completed. Vol. iv is nearly ready, and will be quickly followed by Vol. v.

A NEW edition of the Great Eastern Railway Company's "Tourist Guide to the Continent," edited by Mr Percy Lindley, has been published New, editions of Mr. Lindley's "Walks in the Ardennes" and "Walks in Epping Forest" have also been published, and he has compiled two other useful little hand-books, "Walks in Holland," and "Holdskys in Belgium,"

Masses Guy and Co., Cork, send us "Guy's South of Ireland Pictorial Guide," in which are described and illustrated much fine scenery and various things interesting to students of natural history and archeology

MESSRS DULAU AND Co. have issued a catalogue of the works on geology which they are offering for sale.

THE results of an investigation concerning the cause of the insolubility of pure metals in acids are contributed by Dr. Weeren to the current number of the Berichte De la Rive, so long ago as the year 1830, pointed out that chemically pure zinc is almost perfectly insoluble in dilute sulphuric acid Hitherto, however, the hypotheses put forward attempting to account for this singular fact have been anything but satisfactory The theory of Dr Weeren is extremely simple, and is fully supported by the most varied experiments, physical and chemical It may be stated as follows "Chemically pure zinc and also many other metals in a state of purity are insoluble or only very slightly soluble in acids, because, at the moment of their introduction into the acid, they become surrounded by an atmosphere of condensed hydrogen, which under normal circumstances effectually protects the metal from further attack on the part of the acid" It is found that when a piece of pure zinc is immersed in dilute sulphuric acld, a slight action does occur during the first few succeeding moments. zinc sulphate and free hydrogen being formed in minute quantity The free hydrogen, however, instead of escaping, becomes condensed by the molecular action of the zinc upon the surface of the latter, and is retained there with great tenacity as a thin mantle of highly compressed hydrogen gas, capable of affording perfect protection against further inroad of the acid. The experiments from which this simple and very probable explanation has been derived were briefly as follows. The amount of chemically pure zinc dissolved by the acid was first determined It was, of course, an exceedingly minute quantity. Considering this amount as unity, it was next sought to determine what

difference would be effected by performing the experiment in vacuo, when of course the escape of the hydrogen would be greatly facilitated. The solubility was found under these circumstances to be increased sevenfold. Next the experiment was performed at the boiling temperature of the dilute acid, first when ebuilition was prevented by increasing the pressure, and secondly when ebullition was unhindered, thus again facilitating the removal of the hydrogen film. In the first case, when chullition was prevented, the solubility was practically the same as in the cold, while in the second case, with uninterrupted ebullition, the solubility was increased twenty-four times. Finally, experiments were made to ascertain the effect of introducing into the acid a small quantity of an oxidizing agent capable of converting the hydrogen film to water. When a little chromic acid was thus introduced the solubility was increased 175 times, and when hydrogen peroxide was employed the solubility was increased three hundred-fold The explanation of the case with which the metal becomes attacked when the ordinary impurities are present is that the hydrogen is not their liberated upon the surface of the zinc, but rather upon the more electro negative impurities, leaving the pure zinc itself open to the continued attack of the I he same of course occurs when a plate of platinum is placed in contact with a plate of pure zinc in the acid. The action of nitric acid, the only common acid which does attack pure metals, is evidently due to the oxidation of the hydrogen film by further quantities of the acid, with formation of water and production of the lower oxides of nitrogen, and even under certain circumstances of ammonia

Tits additions to the Zoological Society's Gardens during the past week include a Macsque Monkey (Manacur gementique) from India, presented by Mr. R. Armstrong, two Senegal Touncous (Greythans prens) from West Afren, presented by Sir Brandforth Griffith, Barr , two Rock Thrushes (Montrole Sanatial) from India, presented by the Rev Hubert D Aviley, two Larger Hill Mynahs (Graudis internatia) from China, deposited, two Maile Dere (Garana maneris), Hire Summer Ducks (Ar. sports), seven Mandarin Ducks (Ar. sperins), deven Mandarin Ducks (Ar. sperins), bred present the China Ducks (Arms. sportshool), a Spotted-luide Ducks (Arms. sportshool), a Spotted-luide Duck (John Anaton Aynchin), bred in Carlos (Montrole Montrole Montrole

OUR ASTRONOMICAL COLUMN.

THI. SIRLIAR CLIP-11 Ry PERFI — Mr. O. A. L. Phil has completed a mixmourner examination, beguin in 1870, of the group x of the great star cluster in ferencia, and the results are group x of the great star cluster in ferencia, and the results are classes all stars down to 10 fanginuties, and a number of fainter once down to 117 magnitudes, the total number of stars resulted hering 250. The postorion obtained, joined to those the claster. Frov Vogel has determined the postness of 178 stars in the central part of the x group, but Mr Pihl's investigation of 178 stars in the central part of the x group, but Mr Pihl's investigation of 178 stars in the central part of the x group, but Mr Pihl's investigation of 178 stars in the central part of the x group, but Mr Pihl's investigation of 178 stars in the central part of the x group, but Mr Pihl's investigation of the x group in the composition of the x group in the central part of the x group, but Mr Pihl's investigation of the x group in the x group in

A ring and a bar micrometer were used in the observations, and the reductions were made by the ordinary method of taking half the sum of the moments of lingress and egress in the calculation—a goode of proceeding which depends upon the supposition that the half sum denotes the matent of the passage of

the star through the middle of the ring or bar. This supposs-Use star through the middle of the ring or bar. In its supposa-tion, however, is shown to be erroncoss. For stars of a less magnitude than 5'5 there is always a detention in the apparent tune of emerion, which increases with the faintness of the star observed. The cause of the error, therefore, is physiological, and due to the occaling micrometers employed. The law rega-lating it having been found, the necessary corrections have been applied to the measures, thus rendering the work of greater

use. The memoir represents the work of a business man over a period of twenty years, and with an instrument having an aper-ture of 31 loches. It contains much of interest, and will doubt-less be appreciated as an important contribution to the know-tick and the stars in a cluster which is certainly one of the grandest of telescopic objects

ON THE VEGETATION OF TIRET

ON THE VEGETATION OF TIBET.

In the May number of the Journal of Belonging MM. Bareau I and Franchet describe a number of a general of Belonging MM. Bareau I and Franchet describe a number of new plants from the collections recently brought home by M. Borwide and Prince Henry of Orleans, and give a general summary of their character. The collection was made almost entirely in a narrow band of territory reaching from Lineau entirely in a narrow band of territory reaching from Lineau entirely in a narrow band of territory reaching from Lineau entirely in a narrow band of territory reaching from Lineau entirely in the late of the lineau entirely in the late of the lineau entirely in the late of t tains. The boneysuckle of Tibet constitutes only a small basis about 15 to 14 kg, with interrugide branches. But it is a small basis about 15 to 14 kg, with interrugide branches. But it is character is remarkable. All the Rododendron and Frankles Canadocter is remarkable. All the Rododendron and Frankles former, & myrophenication, Primitis Expression, Primitis former, & myrophenication, Primitis Expression, Primitis former, & myrophenication, Primitis Expression, Primitis General Canado help belong. It is the same with Neutralian Bertal Vision and Canado Sanda (Sanda Sanda Sa

assing eastward in Szechwan the flora puts on a different character. The leaves become larger, the number of flowers

character. The leaves become larger, the number of flowers on each plant increases. There are many Rossocses, Ordnick, and species of Pedicularis, amongst the Composite the genus personal production and processing and there are several resolutions are personal productions and the several production of the second product parallels may be found between the new species found by our travellers in Tibet and those gathered by Delavay in Yunnan.

SOCIETIES AND ACADEMIES.

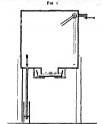
Royal Society, June 18.—"An Apparatus for testing the Secutiveness of Sately-lamps." By Frank Clowes, D.Sc. Lond, Professor of Chemistry, University College, Nottingham. Communicated by Prof. Armstrong, F.K. S.
The following apparatus has been deviced to render easy the

NO. 1133, VOL. 44]

process of testing the sensitiveness of different forms of safety-lamps when used for detecting firedamp. To enable satisfactory test to be made in the laboratory, it was necessary to insure (1) the easy and rapid production of mistures of firedamp and artificially prepared in enhance, which preparented form of the (3) to examine the flame of the lamp under conditions as satisfactory as those estable; in the mine. A wooden cubical box of about too litree capacity was contracted to as to be as nearly gas-tiph as a possible. It was contracted to as to be as nearly gas-tiph as a possible. It was paraffin wax, which was afterwards caused to penetrate more prefectly by passing an ordinary bot flations over the surface.

perfectly by passing an ordinary hot flat-iron over the surface.





This testing chamber was furnished with a small inlet tube at the top, and with a similar outlet tube below. It had a plate-glass window in front for observing the lamp in the interior, and a fianged opening below for introducing the safety-lamp. This pocching was closed by a water-seal consisting of a small zinc opening was closed by a water-seal consisting of a small sine try supported by hattons, and containing about a inches depth of water, into which the flagge dopped. A mixer was arranged, to the section of the chamber, and suspended by a dimensional to the section of the chamber, and suspended by an employ backwards and forwards from the side to the top of the interior of the chamber, by grasping a handle projecting through the bone of the databers, which are a formal properties of the thouse of the databers.

F10 -

When a mixture of air with a certain definite precentage of

finedamp was required, the methons, prepared and purified by ordinary chemical methods, was introduced into the chamber in the requisite quantity by the top index. It displaced an equal volume of air, which escaped through the lower outlet, the exit end of which was scaled by being immersed just beneath a water sprace. A vigorous use of the mixer secured, a uniform maxture surface. A vagorous use of the sainer securids a uniform anxieve and of gas and as throughout the interior of the chamber in the course of a few seconds. The lamp wes then introduced into the chamber, and placed in position behind the glass much discussion of the chamber and placed in position behind the glass midd the necessary opening of the chamber very bord, and the introduced into and removal of the lamp many times in succession was not found to produce any approcable effect upon the composition of found to produce any approcable effect upon the composition of as the cap underwent no further change. A lamp was left dimensions of the "cap" over the finne were noted as soon as the cap underwent no further change. A lamp was left burning in the chamber for a considerable length of time, and of the chamber and the very limited amount of sir required to support the combistion of the unifi flame always used in gastesing. The whole sittener of the chamber and murer were against a black ground. against a black ground.

sganata black ground.
The methane was introduced from an ordinary gas-holder.
The methane was introduced from an ordinary gas-holder,
was poured into the top of the gas-holder. The gas-tap of the
holder was then momentarily opened, so as to produce equilibrium of pressure between the methane and the simosphere
upper niels of the chamber, the water tap was opened, and the
measured volume of water was allowed to flow down and drive the
measured volume of water was allowed to flow down and drive the
measured volume of water was allowed to flow down and drive the
measured volume of water was allowed to flow down and drive the
measured volume of water was allowed to flow down and drive the
measured volume of water was allowed to flow down and drive the
measured volume of water was allowed to flow down and drive the
measured volume of water was allowed to flow down and drive the
measured volume of water was allowed to flow down and drive the
measured volume of water was allowed to flow down and drive the
measured volume of water was allowed to flow down and drive the
measured volume of water was allowed to flow down and drive the
measured volume of water was allowed to flow down and drive the
measured volume of water was allowed to flow down and drive the
measured volume of water was allowed to flow down and drive the
measured volume of water was allowed to flow down and drive the
measured volume of water was allowed to flow down and drive the
measured volume of water was allowed to flow down and drive the
measured volume of water was allowed to flow down and drive the
measured volume of water was allowed to flow down and drive the
measured volume of water was allowed to flow down and drive the
measured volume of water was allowed to flow down and drive the
measured volume of water was allowed to flow down and drive the
measured volume of water was allowed to flow down and drive the
measured volume of water was allowed to flow down and the water was allowed to flow down and the water water was allowed to flow down methane into the cnamuer As soon as ouncies or air ceased to appear through the water at the outlet, the chamber was closed, the mixer was then vigorously worked for a few seconds, and the mixture of gas and air was ready for the introduction of the lamp. Before introducing the methane for a fresh mixture, the atmosphere of the chamber was replaced by fresh air by restantially the contraction of the chamber was replaced by fresh air by removing the water-tray from beneath the opening at the bottom of the chamber, and blowing in a powerful stream of air from a bellows to the top of the chamber

The chamber was supported on legs, which were arranged so as to place it at a convenient height for observations through the window, and also for the introduction and removal of the safety-

The observations were usually made in a darkened room, but the flame-caps were easily seen in a lighted room, provided direct

light falling on the eye or chamber was avoided

The capacity of the chamber was 95,220 c c, accordingly, the following volumes of methane were introduced for 2 per cent instruct 476 cc, for 1 per cent 1952 cc, for 2 per cent.

1904 co., for 3 per cent 2856 cc, for 4 per cent 3808 cc, and for 5 per cent. 4760 cc It will be seen that a sense of tests, in which the above-mentioned percentage mixtures were employed, involves an expenditure of only 15 litres of methane, a quantity far smaller than that required by any other method of testing as yet described

iceting as yet described.

Of many form of safety-lamp tested in the above apparatus, the one which most satisfactorily liftilled the two purposes of effectent illumnation and deletory in gas-testing was at dword's construction, burns bemoine from a sponge reservoir, and its fame is surrounded with a plass optioner, which is ground rough at the hinder part, this latter device prevents the numerous reflected images of the flame, and the generally dilitied reflections which are seen from a smooth glass surface, and which reduce the contraction of a small pale flame approximation. If not impossible.

If not impossible.

The wick of this lamp, when at a normal height, furnishes a fame of great illumnating power. When lowered by a fine serw adjustence the finns becomes bine and non-luminous, serw adjustence the finns becomes bine and non-luminous, which fully bear out the unusual sensitiveness of this finne. With 0.3 per cent. of methane 7 mm.; with 1 per cent. for the finns of the finns of

NO. 1133, VOL. 44]

It appears from the above record of tests that the problem of producing a lamp which shall serve both for efficient illuminating and for delicate gas-testing purposes has been solved. The solu-tion is in some measure due to the substitution of benzoline for oil, since the flame of an oil lamp cannot be altogether deprived of its yellow luminous tip, without serious risk of total extinc-tion, and this faint luminosity is sufficient to prevent pale caps from being seep.

261

From further experiments made in the above testing-chamber with flames produced by alcohol and by hydrogen, it was found to be true in practice, as might be inferred from theory, that, if the flame was pale and practically non-luminous, the size and definition of the flame-cap was augmented by increasing either the size or the temperature of the flame. It is quite possible by edefinition of the finan-cap was augmented by increasing other the size or the temperature of the flame. It is quite possible by attending to these conditions to obtain a flame which, although statement of the conditions to obtain a flame which, although a ball for the measurement of any proportion of gas exceeding; 3 per cent. This must, for the general purposes of the miner, be looked upon as a defect; but it so not a fault of the lamp already referred to. It is of interest to note that with the Pieter spiri-tuage a flame-cap at much in height was seen in au recontaining only 0'5 per cent, of methane

Physical Society, June 26 — Prof. W. E. Ayrico, F. R. S. President, in the chair — The following communications were made — The construction of non-inductive resistances, by Prof. W. E. Ayrico, F. R. S., and M. T. Mahler. In making some transformer tests about three years ago, the authors had occasion to consider the construction of electric conductors the impedto consider the construction of electrix, conductors the impediance of which should be princtically equal to their resistances. This conduito could only be fulfilled by making the inductance mail in comparison with the resistance, and, as the former mail in comparison to the conductor of the former was important to use substances of high specific resistance. Carbon or plasmod being available, the latter was chosen on account of its low temperature coefficient. One form of resistance exhibited consisted of strips of this sheet platmoid about 6 metres long and 4 centimetres with Each was been at the middle and doublet bed, on itself, this tall being and the middle and doublet bed, on itself, this tall being placed between the contiguous parts and narrow ribbon used to bind the parts together. Twelve such strips arranged in series had a resistance of 2'95 ohms, and would carry a current of 15 amperes without changing its resistance more than 15 per cent. This strip-resistance was made by Messrs C G Lamb and E W Smith, who at that time (1888) were students in the Central Institution, and to whom the author's best thanks are due for Institution, and to whom the author's best thanks are due for the pranseous thym manner in which they surmounted the difficulties which present the properties of the properti as assets on permoutirs appointents that the bending moment is proportional to the curvature, the author pointed out that this assumes that the cross-sections remain plane after flexure, and neglects the surface loading effect. The present paper describes experiments made to determine the actual state of strain in a beam doubly supported, and carrying a single load at the centre, the effect of surface loading being taken into account. The the effect of surface loading being taken into account. The method of investigation assumes that (1) the true state of strain at the centre of a beam may be found by superposing on the state of strain due to bending only, that due to surface loading without bending; (2) the state of strain due to surface loading palacements of the state of strain due to surface loading. only, may be found with close approximation to ruth by resting the beam on a flat plane instead of on two supports; (3) the strain due to bending alone, may be obtained from the Bernoulli-Saint-Venant results. Before proceeding to describe Bemoniii-Sant-Venant result telore proceening to oescribe the experiments, a short account of the mathematical work previously done on the subject was given. The nearest approach to the particular case here dealt with had been worked out by Prof. Bousslassed, who had shown that for an infinite elastic solid bounded on one side by a plane surface and loaded along a line on that surface, the stress (y) on an element on the normal through the middle point of the line varies inversely as its distance (x) from the surface. The formula thus arrived at was $y = 0.04 \frac{P}{x}$, whilst for a finite beam centrally loaded the

author's experiments gave $y = 0.726 \frac{P}{r}$. The experiments were made on glass beams mounted in a steel strinking frame, and placed between the crossed Nicola of a polarizope. Steel collera a mu. of the place of the collection of the collection of the beam were measured by a micrometer's cross at point opposition of the beam were measured by a micrometer screw at a point opposition the central load, and traversing provise of the whole frame to be moved so as to bring any portion of the beam in the field of view. Circularly polarized light was somewhat the collection of beam in the field of view. Circularly polarized light was some times used, and a micromater yeprotoc served to measure the distances between interference fringes produced by loading. By carefully chosen experiments the author had shown that if a beam of less as the second of the second of the second of the term of the second of the second of the second of the second of contact of the load is inversely proportional to the point of contact of the load is inversely proportional to the distance from the point of contact. In the first experiment the ownwell Nicols were set at 4g to the axis of the loaded bar, a quarter-wave plate was then placed between the bar and the analyzer, and the position of the black gots at the point where the effect of the shear on the polarized light was equal and opposite to that protimes by in requirements plate when noted by a second on proven the province of the first point on the first, is the black spot moved upwards to a point where the shear was double that at the first postulor. This position having been determined, one quaren-wave plate was removed, and the load dismoushed until the original spot moved up to the second position, and until the original spot moved up to the second position, and which the shears were in the proportions 1, 2, 4, 8, 8c., were determined. Flotting the results showed the curve connecting the shear and the distance from the point of contact to be hyperbolic. Other experiments showed that the shear at any point and measuring the distance between the interference fringer below the point of contact the hyperbolic law was confirmed. duced by the quarter-wave plate was noted. A second quarterand measuring the distances between the intersections tringer below the point of contact the hyperholic law was confirmed. The effect of bending a beam is, according to hypothesis, to put the upper portion in longitudinal compression, and the shear the upper portion in longitudinal compression, and the snear (vertical stretch) varies as the distance from the centre of the beam; the shear due to surface loading is a vertical squeeze, and, as shown above, varies hyperbolically When, there fore, the beam is subjected to both actions, the straight line presenting the bending strain may intersect the hyper-la representing the shear due to surface loading in two bola repres points, and since, at the corresponding points in the central section, the shears are equal and opposite, the elements are only subjected to voluminal compression, and will exert no bi-refringent action. Hence, when viewed through crossed Nicols, black spots will be seen on a white field Keeping the lead constant and diminishing the span should cause the spots to approach each other, and when the line is tangential to the hyperbola, the spots coincide These deductions were conhyperbola, the spots coincide. These detuctions were confirmed by experiment, and it was found that for a span of less than four depths, no point of zero shear exists on the central section The strain in beams subjected to surface loading were this shown to be of a character different from those usually assumed, the neutral axis instead of coinciding with the axis of assumed, the neutral and instead of concerning with the axis of the beam, being lifted up in the centre, and its shape-depending on the load and span. Other ingenious and unteresting experiments on beams were described, in some of which the lines of principal stress were mapped out. Remarkable results were obtained, showing that although the tension lines given by Rankine and Airy are nearly correct, the curves of compression may be very different, and have very curious shapes Prof. Perry thought the local loading effect would not be so important Perry thought the local loading enect would not us so important in long beams, and inquired whether in ordinary test pinces local loading would affect the breaking strength. He also asked what effect the fact of the load making contact over a surface instead of along a line would have on the results, and in repty Prof. Carus. Wilson saul the effect was to raise the asymptote of the hyperbola representing the surface loading stress above the surface of the beam —On pocket electrometers, by C V Boys, F R.S. This communication described modifications of electrore K.S. Into communication describes monatons of electro-meters adapted for portability. As quarts fibres increases the delicacy and diminish the disturbing influences affecting instra-ments, much smaller controlling forces can be employed than when silk is used for supersinons. He had, he said, pointed out some time ago the great advantages arising from making

galvanometers small. Applying similar reasoning to electro-meters, he remarked that making an instrument one-tenth the size of an existing one reduced the moment of inertia of the needle to I whilst the deflecting couple for given potentials would only be 1/2 of its former value. The small instrument would for the same periodic time be 10,000 times more sensitive than the large one, provided the distarbing influence could be would for the same periodic time be 10,000 times more sensulvish than the large one, provided the distarting milaners could be to distarting milaners could be to ordinarily possible, for any method of making contact with the meedle, such as by a fine were dispoling into seld of or mercary, prevented very small controlling forces being used. Sill, type stands develors a large proportion of the fill advantage could tack was essential to success. The first instrument described was one in which the needle was cynindrasl, contiguous quarters being insulated and connected to the opposite ends of a minute the medium of the control of t potentials. This bold experiment proved remarkably successful, for the instrument was very sensitive A disk shaped needle for the martument was very sensitive A dask shaped needle with quadrants, stlematedy sinc and platium, was then employed, and by this a small fraction of a voit could be measured, as the control of the could be measured as the could be turned used to down or carried shout in the pocket with impunity. Another small instrument with the stitutionary quadrants of irms and copper was exhibited, and by rotating them through an angle to you to as to bring the country of the stons relating to ballistic electronieters and electrosistic Stemens dynanometers, and pointed out the possibility of instruments such as he bad exhibited being of use in elucidating the obscure points in connection with so-called "contact electri-city." The President complimented Mr. Boys on the beautifully simple and remarkably sensitive electrometers exhibited. He simple and lengthany sensitive electroneers enforced. He remembered that some years ago Mr Gordon made a very small electrometer, but its insulation was insufficient for electrostatic work He agreed with Mr Boys as to the advantages of small instruments, providing sparking across or tilting of the needle could be prevented On the other hand, he thought the use of small potential differences on the needle was a step in the use of small potential differences on the needle was a step in the wrong direction, when great sensability was required. Prof. Ferry asked if the needle could not be kept changed by Coccasional contacts with a changed and cup. Mr. Boys and he had not yet done so. It is also suggested that an electrometer of very small capacity might be made by reducing the quadrants surrounding a dusk-needle, until they became like small tuning-forks—A paper on electrifaction due to the contact of gases with lequids, by Mr. J Enright, and one on the expansion of chosine by feed, by Dr. Arthur Richardson, were taken as

Entomological Society, July 1.—Mr. Perdernic DuCanscodman, F.R.S. President, in the chair.—Mr Jacoby exhibited a specimen of a species of Coleoptera belonging to the family devicesally, with the maxiling-a play extraordinantly developed. Goldensulla, with the maxiling-a play extraordinantly developed. Forests, Poons, exhibited specimens of a long imitating as any Expression of the Coleopter of the Coleopter of the Coleopter of the Maxilia, and read the following notes:—"I have taken a good ministion of Poperatin springer (under the same store with which it may be found), even to the extent of evolving a pedicide and spines in which, were it as any would be its metanotium, and the coleopter of P. gissager, and thus to set the ball of avoigion rolling afrenh is at that the present rough copy of seingler's pines is found sufficient to deceive? The bug has also been found in the Migheries. M. Rothney remarks on the above species —"I have not found the speciel numericing Mistillia, but in Calcutta the Company of the Company of

EDINBURGH.

Royal Society, June 15 —Mr. T. B. Sprague in the chair.— Dr Johnson Symington and Dr H A Thomson communicated a paper on a case of defective endochondral ossification in a a paper on a case of detective endocaonari ossincation in a human foctus.—Dr. J. Berry Haycraft read a paper on the alkaline and acid salts of the blood and urine, and especially those of phosphoric acid —Dr. J. M. Macfarlane presented the second part of a paper on the structure, division, and history of vegetable and animal cells, in which he stated that as a result of extended observation he still adhered to the view that result of extended observation ne suil someted to use tree tina a typical cell consists of protoplasm, nucleus, nucleous, and endonucleous, the whole usually surrounded by a cell wall, that the nucleolius is the important part equally in division and in sexual union of cells, that after division had ceased, successive fragmentation of endonucleolius, nucleolius, and nucleus occurred, fragmentation of endonucleolius, nucleolius, and nucleus occurred, ingmentation of automaterium, nucreous, and nucreo occurren, though to a varying degree in different cells, that thus a multi-endonucleolar was followed by a multinucleolar, and this by a multinuclear state. He regarded the nucleous of every cell as the sexual centre directly derived from union of the chromatic the sexual centre directly derived from union of the chromatic substance of the male and female pronucled of the orum, and that from the nucleolus extremely fine radiating threads of chromatic substance passed out along the schromatic fibrils, which last he viewed as a finely differentiated reticulum of the ground protoplasm By union of the radiating chromatic threads, the ambor considered that the nuclear membrane was formed, while continuations radiated outwards from this through the cell-protoplasm to convey stimuli to and from the sex-centre or nucleolus He further stated that many facts and direct observations made tended to show that the radiating threads from the nucleus, and ultimately therefore from the nucleolus, of one cell are connected with corresponding ones from other cells, and this, if fully verified, would cause us to regard an organism as a sexual whole, and the male and female reproductive cells as being specially set aside to hand down hereditary and acquired conditions. He showed that this town interesting and acquired communities are snowed that this had a special bearing on the next communication submitted—a comparison of the minute structure of plant hybrids with that of their parents, and its bearing on bological problems. At a previous meeting of the Society (May 4) he directly demonstrated by these parental leaves are stretch. strated, by three parallel lantern exhibitions of micro-photo graphs, that the usaues of root, stem, leaf, and flower parts in the hybrid named by Dr. Mastera Philageria Vestchii, are exactly the hybrid named by Dr. Massers Fringeria Festicias, are exactly intermediate, when of corresponding age, between those of the parents; and further, that when a structure is developed in one parent, but is absent in the bother—of the sepal honey gland of Lapageria—the hybrid shows it to half the time. He now referred to determ other bybrids whose tusses he had worked over in detail, and selected points from about sixty others,

NO. 1133, VOL. 44]

examined more or less minutely. By triplets of micro-photographs the author not only demonstrated that a hybrid is, to its minutest details, a blended reproduction of both parents, but that where the parents show diverse morphological details, it is a supplementation of the parents and the condition of the parents show diverse morphological details, and then compared the tusses of Cyriuss Adams' (see sho Gard. Carran, July 1890, p. 94), which he regarded as a true graft hybrid. He concluded by referring to the colour, flowering high the colour production of the colour, flowering high the day by these inquiries on the effects of environment, on the influence of sex, and on heredity —Prof. Tait communicated paper, by Prof. Solkes, on an optical prof of the existence of sex, and on heredity —Prof. Tait communicated and the colour should be considered to the colour should be considered in the colour prof. The customer of colour should be considered in the colour should be coloured by the colo

SYDNEY

Royal Society of New South Wales, May 6—Annas Meeun,—Dr. A. Leibus, Fresden, in the char. The Report stated that 25 new members had been elected during the year, as the state of the property of the property

PARIS.

Academy of Sciences, July 6.—M Duchartre in the chair.—On the hunar inequality of long period due to the action of Yeans, and depending upon the argument (+ 16.7 - 87.5 ps M. F. Tussrand According to Delaunay, in calculations of this requality it is possible to neglect powers of the inclination of the orbit of Venus higher than the second. M. Tuserand show, however, that terms which contain the fourth power of the

tachisation may have a sessible influence, and dimunish the conficient of the incumulaty in question by a tenth of it witnesshale is, by about 1" 5.—On the meaner in which the velocities that it, by about 1" 5.—On the meaner in which the velocities exciton widened at the mouth up to the points where uniformity as enablished, by M. J. Bonssinesy.—The flight of insection widened is the mouth up to the points where uniformity as enablished, by M. J. Bonssinesy.—The flight of insections are considered as a post-partial which is has used to obtain bloodgraphs of flying unsects. It allows exposures to be made so short as writes of a second. His observation indicate that the wings of writes of the control of inclination may have a sensible influence, and dimunish the cochloride with boron tri-locide, the trachloride of boron and the terra-locide of carbon are obtained by double decomposition. A denaled account is given of this reaction. The carbon terral carbon are considered as the control of the carbon are described by the beautiful erd colour, very smalls: to the rubble synthetically prepared by MM Freny and Verneuil. Several new reactions with this compound are described.—Compounds of camphoes with the addedyder: on a new mode of formation of allyst Algeria, by MM Porenla and Fichera. It has been previously shown that the Eccene formations of Algeria may be divided into the three groups, lower, medical, and upper The observations now stated indicate that the Maldet Eccene formation into the three groups, lower, medical, and upper The observations now stated indicate that the Maldet Eccene formation by Nummilton of the groups Numm lengate and Numm, perfectation. The Lower Eccences are defined from a nummality of the control of carbon control of the control o chloride with boron in-todate, the trigging of terminodide of carbon are obtained by double decomposition. A E. Mercadier. Experiments have been made to determine the relation - for solid sonorous bodies, and, therefore, the coefficient

of dynamical disations, by a method founded on Kirchhoff's theory of vibrations of circular disks. From the results obtained with steel tends to make the alloy sociopic. The mean coefficient of dynamical elasticity for alloys containing about 5 per cent. and 55 per cent of maked is 18,600, whereas that of pure steel is 20,700.—Calculation of molecular volume, by M. G. Hinrichs.—On an exploruse compound which results from the Hintens—On an explosive compound winth results from the action of baryta water on thront and in the presence of coverance of the presence of the presence of an excess of oxygenated water, a precipitate in produced, which, after descention, explose violently by heat or percussion. The compound has the formula BaO, CrO,—O the detection of small quantities of horiz add, by M F On the detection of small quantities of hort acid, op a re-paramentier.—On the structure of the occilates of Lithosius for-ficatiut, by M Victor Willem—Comparative study of the development and morphology of the parapodia of Sylhdies, by M. A. Malaquin.

GOTTINGEN.

Royal Society of Sciences—The Proceedings of the Society for February, March, and May 1891 contain the following papers of scientific interest:—
No 1.—W. Nernat: on Henry's law of chemical equilibrium in solutions—F. Meyer on discribingants and resultants of singularity-equations.—O. Venake: contribution to the integration of the equation $\Delta^*u = 0$ for certain plane figures (the disk; the annulus, the rectilineal angle, the rectilinear strip with parallel sides, the annular sector).

possible ades, the annular sector).

No. 2—W. Vogi c contributions to hydrodynamics (pulsating sphere or cylinder us an infinite liquid, sationary) and the property of the property of the state of the property of the state of

mination in absolute measure of the internal thermal conductivity of badly conducting bodies.

STOCKHOLM.

Royal Academy of Sciences, June 10.—On the treatment of cancer through (njestona, by Prof. Rostander.—Analysis of cancer through (njestona, by Prof. Rostander.—Analysis of the Rostander.—An ties methods of Angitrom and Neumann for determining the conductibility of heat in bodies, Part in, by Dr. Hagstrom —On 1-6 dibrom-naphthaline, by Herr Forsling, —Traxol combinations produced from aldebydes and dicyan-phenyl-hydrazine, by Herr Holmqvits —On the ammonaesi combinations of iridium, by Dr. Bales Co. 11. by Dr. Palmer —On the ammoniated combinations of intuiting by Dr. Palmer —On the formulas for calculating the mortality during the first year of human life, as derived from the statistics of the population, by Dr. G. Enestrom

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

CONTENTS.

PAGE

Organizers of Technical Education in Conference	
(With Map)	24
The Evolution of Animals By R Lydekker	24
Metallurgy By Prof W. C. Roberts-Austen, F.R.S.	24
Bacteria and their Products	24
Our Book Shelf:-	
Gordon: "Our Country's Flowers."-C. H. W	24
Pascoe: "A Summary of the Darwinian Theory of the Origin of Species."—R. M.	
the Origin of Species,"-R, M,	24
Rae: "The Business of Travel"	24
Latters to the Editor:-	
The Albert University Prof. G. Croom Robert-	
son; Rev. A. Irving	24
Name for Resonance -Prof. Oliver I. Lodge.	
F.R S.	24
Force and Determinism Prof. C. Lloyd Morgan :	
Edward T. Dixon	24
Magnetic Anomalies —Alfonso Sella	24
Physical Religion -B. Woodd Smith	24
Some Applications of Photography. (Illustrated.)	~
By Lord Rayleigh, F R S.	24
The Smithsonian Astro-physical Observatory	25
The New Gallery of British Art	25
Cardinal Haynald	25
Oxford Summer Meeting of University Extension	-,
Students	25
The Proposed Teaching University for London	25
Notes	25
Our Astronomical Column:	~>
The Stellar Cluster x Persei	25
	26
on the vegetation of Tibet	

THURSDAY, IULY 23, 1891.

THE TEACHING OF FORESTRY

A Manual of Forestry By William Schlich, C.I.E., Ph.D. Vol II (London Bradbury, Agnew, and Co, 1889.)

N a loop of the Main river in Lower Franconia, east of Aschaffenburg, rises an extensive mountainous country, clothed with almost unbroken forest of singular beauty and of enormous value. It is the Spessart, in old times known as the home and haunt of great highway robbers, but also known from time immemorial as the home of the best oak timber in Germany The red sandstone of the Trias, which everywaere is the underlying rock in this extensive forest country, makes a light sandy loam, which, where deep, is capable of producing tall, cylindrical, wellshaped stems Having grown up, while young, in a densely crowded wood, the oak here has cleared itself of side branches at an early age Hence these clean straight stems, which in the case of spruce, silver fir, and other forest trees, may justly be said to be the rule, but which the oak does not produce, save under these and similarly. favourable circumstances The species here is Quercus sessibiliona, this species does not form pure forests, but is always found mixed with other trees, the hornbeam, the beech, and on the lower slopes of the western Schwarzwald, the silver fir In the Spessart, the beech is associated with the oak, in the same manner as the bamboo is the chief associate of the teak tree in Burma.

In publishing his manual of forestry, the author wished in the first instance to place in the hands of the students at the Coopers Hill Forest School a handbook to facilitate their studies That Forest School was. tt may be remembered, established in 1885, in connection with the Royal Indian Engineering College at the same place, in order to give the needful professional training to young Englishmen who desired to enter the Indian Forest Department. Accordingly, when the first volume of that manual appeared in 1889, it was natural that some, who took a strong interest in the progress of forest management in the British Indian Empire, were surprised that the book did not deal with Indian trees, and that its teaching related to the oak, the beech, the Scotch pine, and other trees of Europe. By some of these zealous friends of Indian forestry the book was pronounced a failure, because it did not treat of Indian forest trees

The principles which guide the forester in the proper treatment of his woods are the same all over the world, in India as well as in Europe. But while the application of these principles to the treatment of Indian forests is not more than thirty-five years old, the methodical and systematic treatment of European forests is of old standing, and has stood the test of experience. In the teak forests of Eurina, the bamboo has a position similar to that of the beech in the oak forests of the Spessart. Oak and teak are both trees with comparatively light foliage. Pure woods of these species, while young, are sufficiently dense to shade the ground, whereas at an advanced age the wood get their, the canopy light, and the results is that

grass and weeds appear, and that by the action of sun and wind the soil hardens and is less fertile than the loose porous soil, which is shaded by dense masses of foliage. Hence the advantage of associates, which, like the beech in Europe and the bamboo in Burma, shade the ground with their dense foliage and enrich it by the abundant fall of their leaves. But it is not only the condition of the ground which is improved by these useful associates. Teak and oak have this specialty also in common, that, when growing up alone, their stems, instead of running up into clean cylindrical boles, are apt to throw out side branches. which greatly impair the market value of the log. But when growing up in dense masses with their natural associates, these latter, crowding in as they do on all sides, around the oak in the Spessart and the teak in Burma, prevent the development of side branches and thus produce clean and regularly shaped stems

In these and many other ways are the associates of the teak and of the oak useful friends, so to speak. Under certain circumstances, however, and at certain periods of their life, they are dangerous enemies to their more valuable companions On the sandstone of the Spessart and elsewhere, the beech, as a rule, has a more vigorous growth than the oak; it gets the upper hand, and, unless it is cut back or thinned out in time, the oak, if both are growing up in an even mixture, has no chance The bamboo is even more formidable as an enemy of the young teak tree. Though the teak may have had a long start : if a crop of bamboos-either the shoots of old rhizomes, or perhaps the result of general seeding of the old bamboo forest, cleared away to make room for the teak-springs up among it, the teak is doomed. As soon as the rhizomes of the bamboo have acquired sufficient strength, they produce, within a few weeks, during the rains, such a profusion of full-sized shoots, say 20 to 30 feet high, that the young teak trees among them are throttled and extinguished.

The similarity in the relations of teak and bamboo in Burma, and of oak and beech in the Spessart, has led foresters in both countries to devise similar arrangements for the regeneration of these forests. In the Spessart, when the old timber in a compartment of the forest is cut, the best places for the growth of the oak are selected, and the oak, which here sells at the rate of from 2s, to 3s, a cubic foot for sound and well-shaped pieces, is sown on soil most suitable for its development; while the beech, the timber of which only fetches about one-fifth of that amount, is allowed to reproduce naturally from self-sown seedlings over the rest of the area. Among the oak also a certain but small proportion of beech springs up, and even where pure oak woods may be the result of these proceedings, it will not be difficult, when they are sufficiently advanced, to introduce such a proportion of beech as will secure their satisfactory development. In the same way in Burma, selected areas are cleared for the growth of teak in the original forest, the clearance being effected and the teak planted with the aid of that rude mode of shifting cultivation, known as the Toungya system.

Many other instances might be quoted, in which similar practices have developed in the rearing and tending of woods in Europe and in India. The principles of sylviculture are the same everywhere, and the application of these principles to the treatment of woods in different

^{&#}x27;See NATURE, vol zli p 121

parts of the globe has, in many instances, led to the adoption of similar methods: hence Dr Schlich was right in selecting the timber trees of Europe to illustrate the application of these principles in the manual before us.

Sylviculture, the author explains, is the formation and tending of woods, and he divides his subject into four chapters. The first of these chapters treats of preliminary works, such as choice of species, fencing and reclamation of the soil by draining, the fixation of shifting sands, the breaking through of an impermeable substratum (pan) and the like In regard to the fixation of shifting sands. an interesting account is given on p. 33 of the methods which have been most successfully practised on the west coast of France, in order to stop the progress inland of the coast dunes, and to clothe these ridges of rolling sand with a productive forest of the cluster pine (Pinus Pinaster) A belt, in many places five miles wide, along the coast of Gascony, and considerably further north, has in this manner been reclaimed, and the steady progress of the sand, which had covered large areas of fields and meadows, and which had destroyed numerous villages, has thus been arrested

Chapter ii deals with the formation of woods by artificial and natural means. The Spessart, which has been mentioned above, is an instance in which both artificial and natural means are used in order to effect the regeneration of the forest, so as to insure the production of timber of the highest possible commercial value. In most large forest districts on the continent of Europe, both the natural and artificial method are employed As the author says on p 178, neither the one nor the other system "is the best at all times and under any circumstances; only a consideration of the local conditions can lead to a sound decision as to which is preferable in a given case" In France, for instance, a country highly favoured by a climate uniformly moist and mild, where most forest trees produce seed more frequently than in Germany, natural reproduction may, broadly speaking, be said to be the rule and planting the exception But in France, also, planting operations on a large scale have been carried out on the dunes of the west coast as well as on bare mountain-sides of the Alps. the Cevennes, and the Pyrenees, and, wherever necessary, planting is resorted to, to supplement the natural regeneration of the forests

An instance in which over a large extent of country the forests are regenerated artificially may be found in the State forests of the kingdom of Saxony, together with most of the communal and many of the private forests in that country. The State forests of Saxony cover an area of 432,000 acres, and by far the larger portion of this area is stocked with pure spruce forest treated on a short rotation of eighty years, and regenerated artificially by planting The high prices realized in this industrious and thickly populated country, even for timber of small sizes, have gradually led to the adoption of this system; and the State forests of the kingdom of Saxony are a pattern of methodical and most successful management. The forest ranges, all in charge of highly trained superior forest officers, are small, containing not more than 2000 to 3000 acres each, and many of these ranges have a steady regular annual yield of 140 cubic feet of timber per acre, and for foresters proceeding to India. For in that large

and local of 100 marks per hectare, which corresponds to forty shillings an acre

But in Great Britain also, and in Scotland especially, is the system of rearing forests by planting well understood. and it is practised over large areas economically and successfully. French as well as German foresters of great practical experience have repeatedly expressed their high sense of the skill and ability with which large plantations are formed in Great Britain at a comparatively moderate cost. But even foresters and wood-managers in Great Britain may learn a good deal from this portion of Dr. Schlich's book Their attention might specially be directed to the author's remarks on p 113, regarding transplants which have developed a lopsided root system, "because the trenches, into which the pricked out seedlings are placed, are often made so shallow, that the root system of the plants, instead of assuming a natural position in the ground, is altogether bent to one side."

That section of the second chapter which deals with the natural regeneration of woods, necessarily divides itself into two portions first, natural regeneration by seed; and second, by shoots and suckers (pollards and coppice). Concise brevity is one of the great merits of Dr Schlich's manual, and it doubtless was necessary to curtail, and to make a rigid selection of the most important matters. But the treatment of coppice woods and of coppice under standards might perhaps have been a little less brief.

As regards natural regeneration by seed, the Black Forest in South-Western Germany may be quoted as an instance where, over extensive areas, the forest is chiefly regenerated by natural means. The splendid logs of spruce and silver fir, which are floated down the Rhine in numberless huge rafts, have all grown from self-sown seedlings. and most of the young timber now growing up has had the same origin The timber which is brought to market from these forests is much older and heavier than that sold in the forests of Saxony, but the results of management are to some extent similar. There are some forest ranges in the Schwarzwald, both in the grand-duchy of Baden and in the kingdom of Wurttemberg, which yield the same annual quantity of timber per acre, and furnish the same rate of net revenue to their proprietors, as those of Saxony. The term of rotation, of course, is much longer, and the system of natural reproduction takes time, hence the money value of the growing stock of old timber is very large, much larger per acre than in Saxony. The interest, therefore, on the capital invested (value of land plus growing crop) is less in this case. The discussion of these matters, however, does not appertain to sylviculture, but to forest management, with which the author will deal in a subsequent volume of his work.

As already mentioned, in France the natural regeneration of forests is the rule, chiefly owing to its wonderfully favourable climate. Large areas, mainly of private and communal forest, are managed in admirable style, as coppice woods and as coppice under standards. The treatment of high timber forests also, and their regeneration from self-sown seedlings, by means of a regular system of successive cuttings, has in France been brought to a high state of perfection. This circumstance renders the French forests specially valuable as a field of instruction furnish a net revenue, after deducting all charges, general | country, though planting has been commenced and must

necessarily be carried on in some instances on a large scale, yet every effort ought to be made to develop good systems of natural regeneration in the different provinces

On pp. 132-64 the author gives a clear account of the different systems which have in course of time been devised, in order to effect the natural regeneration of woods by seed Under the more favourable climate of France the desired object is generally effected by a simple and to some extent uniform system of successive cuttings In Germany, on the other hand, where droughts are frequent, frosts severe, and where good seed years generally are of rare occurrence, the system of regular successive cuttings, which originated in Germany, in many cases was found to fail, and accordingly, some sixty or seventy years ago, the tide set in in favour of artificial reproduction A reaction, however, has for good reasons taken place in many parts of the country, and during the last thirty years German foresters have been busy in adapting the system of natural regeneration to the peculiar conditions of each forest district. Indian forest students should go to France, in order to become impressed with the fact that under favourable circumstances natural regeneration of high forests may be effected by a simple and easy system of treatment ln German forests, on the other hand, they should learn how the difficulties of a climate frequently unfavourable have been successfully overcome by devising systems of treatment suitable to the requirements of each locality, and the knowledge here acquired will be most useful, nay, necessary, to them in India, where the conditions of climate by no means always favour the natural regeneration of the more valuable forest trees

Space forbids a full discussion of this most important and interesting subject. This portion of Di, Schlich's book, if supplemented by the study of forests on a large scale, particularly in Germiny, will be most useful to foresters who may be called upon to devise methods of forest treatment in other parts of the globe, be it India, Australia, South Africa, or North America.

Closely allied to the subject just adverted to is what the author says in the fourth section of the same chapter regarding the formation of mixed woods. Pure woods, consisting of one species only, are exposed to various risks, from which mixed woods are exempt. Hence, in most Continental forests, there has of late years been a strong tendency in the direction of favouring the growth of mixed woods, such as oak and beech, oak and hornbeam, oak and silver fir, Scotch pine and beech, and the like. It goes without saying, that operations in this direction, in order to be successful, must be guided by careful study of the mode of growth and of the peculiar requirements of the different species in different places and under different conditions. Something has been said above regarding the treatment of mixed woods of oak and beech in the Spessart. But it does not follow that oak and beech behave in the same manner everywhere. On certain kinds of shale, belonging to the Devonian formation, for instance, the oak rather than the beech has the tendency to take the lead, and here mixed woods of oak and beech can be produced from self-sown seedlings much more easily than would be possible on the sandstone of the Spessart. Again, along the foot of the Western Schwarzwald, where, as already stated, the

silver fir is associated with the oak, this tree, though a shade-bearer like the beech, renders it much easier for the oak to hold its own in an even-aged mixed wood, because in its early youth it grows very slowly, thus gring the oak a good start in life

Chapter II teaches how woods should be tended during carly youth and afterwards Passing over what the author says regarding cleaning of young woods and pruning, we come to thinning operations. On p. 200 an interesting statement is given showing the number of trees per acre in certain mixed woods of the 5chwarzwald. The figures are as follows.

Thus, during the life of a wood, and this holds good in all cases, the number of trees per acre decreases gradually from several thousand to a comparatively small number at maturity When, as usual, the object is to produce high class timber, with clean well-shapen stems, the rule 15, as the author correctly states it. " The wood should be thinned lightly until towards the end of the principal height growth, then the thinnings should gradually become heavier, so as to assist a selected number of trees by the gradual removal of all those which are inferior and diseased" In its youth the wood is crowded, the young trees maintaining a severe struggle for existence. The weaker trees are suppressed and some are actually killed, while the rest are either dominant trees, with their head well above the others, or dominated, though not suppressed Formerlythinnings were generally done by rule of thumb, the dead, oppressed, and a portion of the dominated trees being removed. But it is obvious that, when the object is to produce valuable timber. thinnings must so be managed, that the trees which are destined to attain the term of rotation, and which will form the final crop to be cut down, in the example here given, 262 trees per acre 100 years old, shall be sound and regularly shaped. It is obvious that to attain this object dominant trees also may occasionally have to be removed, if unsound, spreading, or irregular shaped, and this is properly recognized by the author. He justly adds that in such cases dominated and even suppressed trees may have to be spared in order to keep the ground well under cover. Such would he the practice in the case of woods consisting of one species only, or of several species of equal value Where one species, such as oak or teak, is of much greater value than the others, all thinnings must, as a matter of course, be so arranged as to favour this species at the expense of the rest

So far concerning the thinning of crowded woods. The last section of the same chapter deals with the tending of open woods for the production of large timber Into this subject, which is one of some difficulty, though of great importance, it would lead too far to enter on the present occasion.

Chapter 1v. contains sylvicultural notes on British forest trees, with notes (by Prof. H. Marshall Ward) on botanical characters serving to distinguish the principal British forest trees. The two species of oak dealt with in

the sylvicultural notes are Ouercus pedunculata and Overcus sessilutora. Botanists are well aware that the maintenance of distinctive characters between these two and others of the European species of Quercus is difficult, so much so, that the best authorities on English trees have decided to re-establish the old species of Linnæus, Quercus Robur, and to regard the two species named merely as forms or varieties. The forester has a different task, and for him the mode of growth and the requirements of these two oaks are so different that he must keep them separate. It will suffice to mention one point, which has not perhaps been brought out sufficiently by the author The mixed woods in which Quercus sessiliflora is associated with the beech, the hornbeam, and the silver fir have been mentioned above. In natural high forests this species is only found in company with other trees, and particularly with the three kinds named. The pure or nearly pure coppice woods of Quercus sesuliflora in France and Western Germany are an exception, these, however, have been converted into pure woods by the longcontinued cutting out of beech, hornbeam, and soft woods. Ouercus pedunculata, on the other hand, does form pure high timber forests of considerable extent Such are found both in Northern and Southern Europe. not on hilly ground, but always on deep alluvial soil. Instances are the forests on low ground along the Elbe and other rivers of North Germany, the magnificent pure forests of that tree on the banks of the Adour river near Dax in Gascony, and similar ones in the peninsula of Istria, south of Trieste There is underwood on the ground in the forests named, but it merely consists of thorns and low shrubs. The two species, Ouercus sessiliflora and pedunculata have different requirements and require somewhat different treatment. This, however, is a small matter These sylvicultural notes are most valuable, and it is satisfactory that the Weymouth pine and the Douglas fir have been included among them.

The second volume of Dr. Schlich's manual, like the first, will be an immense help to the students who are trained at the Coopers Hill College for forest service in India. It will be a great bono to all who are charged with the management of forests in India, in the colonies, and in the United States of North America. And it may perhaps be hoped that in Great Britain also this excellent book will in course of time tend to awake an ome general interest in the good management of its woodlands, which are very extensive, and which some day may be of considerable importance and of great value to their proprietors.

D BRADISS.

THE APPLICATIONS OF MODERN CHEMISTRY,

Dictionary of Applied Chemistry. Vol. 11 (Eau-Nux). (London: Longmans, 1891.)

THE editor of a dictionary of applied science, such as the volume before me, has in these days no envisible task to perform: much is required of him, and the difficulties with which he has to contend are great. Prof.

NO. 1134, VOL. 44]

Thorne has acquitted himself well, for though there may be, indeed there are, many points with which the expert can find fault, yet these are generally matters of detail. and on the whole the work has been satisfactorily done. so that the second volume will be found to be quite up to the high level of the first. The industries which owe their foundation to the science of chemistry now progress with such grant strides, that processes which last year were the newest and best may this year be so improved as to be rendered obsolete, so that an article printed at the commencement of a volume may become antiquated before the last article is in type, whilst data unattainable when the article was written are superseded by some more recently published. As an example of this, I may take that upon "gas coal," written by a most competent authority, Mr Lewis Wright. On p. 177 will be found a table giving the weight of coal carbonized by all the authorized gas undertakings in the kingdom, exclusive of those of local authorities, for the year ending March 25, 1886 Since these tables were printed, a Board of Trade return for 1890 has been published In 1886, 8,378,904 tons of coal were carbonized; in 1890 the figure rose to 9,663,011 In 1886 the mileage of mains was 18,967, in 1890 it had increased to 21,584. These numbers point out the enormous extent of the coal-gas industry in this country, and show clearly that it is not suffering from the competition of electric lighting . indeed, this competition is favourable to the sale of gas, for we see that our streets are now better lighted than formerly, and the consumption of gas in many shops is increased, in order to vie with the splendour of their neighbours' electric light.

As a critic is bound to criticize, I may point out some few faults of commission and omission which have struck me in reading through this generally excellent article

The important steps which have recently been taken in many large works for charging and drawing the gas retorts by mechanical means are barely referred to. Great economy is doubtless effected where such laboursaving mechanical appliances have been adopted, and a description of these would have been of interest, as the labour agitation in our gas-works has brought engineers face to face with this question. Another point upon which a statement would have been of value is the most improved arrangements of the purifying house, and the methods adopted for charging and discharging the purifiers That " the whole of the sulphuretted hydrogen, carbonic acid, and carbon disulphide can be easily and economically removed" (p 200) by a combined system of oxide and lime, and with a proper arrangement of purifiers, is a statement to which many gas engineers will demur The London companies, especially, who have a legal standard limit for sulphur compounds, find it both difficult and expensive to keep down the impurities to the necessary point. The illustrations given in this article are scarcely worthy of the letter-press. Figs. 22 and 23 do not give an idea of the construction of a modern gas-holder, some of which now have the enormous capacity of ten million cubic feet, and are marvels of engineering skill. A description of the latest improvements would have added interest to the article.

As an instance of the rapid progress of an industry interfering with an adequate account being published in the early pages of such a volume, I may refer to the article on electro-plating, by Prof W. C. Williams, which, although giving a clear account of the older processes scarcely represents the position of to-day. Thus no reference is found to recent methods of the electro-deposition of metals, as, for example, the Elmore copper process, or to that of plating by alumnium in or does any mention occur of the electric power suitable or used for depositing metals.

To justify the opinion that this volume is no unworthy successor to that published last year. I would refer to a few articles which are certainly the best I know on their several subjects First, "Explosives," by W. H. Deering. coming from the pen of one who has had long experience in the Chemical Department of the Royal Arsenal, Woolwich, is, as we should expect, up to the level of the time. and in every respect excellent Second comes Prof. Percy Frankland's article on fermentation. No one is more competent than he to write on this most fascinating subject, and his article reads like a novel, and even better. for "truth is stranger than fiction", and Percy Frankland tells his story so clearly and well that I will not spoil the pleasure of his readers-and they ought to be many -by any attempt to abstract its results Thirdly, the article on "Matches," by Mr. Clayton, may be cited as an admirable treatise on this important branch of chemical manufacture, condensed into 24 pages. Not the least important contribution are the nine tables giving. in chronological order, lists of the numerous patented and other inventions in this department of chemical technology Lastly, I will select Mr Wynne's exhaustive article on naphthalene as perhaps the most able and valuable in the whole volume. When we learn that, although it occupies 65 pages of the dictionary, it treats exclusively of the derivatives of one hydrocarbon, and only of those of them which are now used in the arts. and valuable for industrial purposes, we begin to form an idea of the extent and importance of the results of modern organic research, which has opened out regions illimitable, leading to practical results such as the chemists of the last generation would have deemed impossible.

In a dictionary of applied science the question of selections seven more difficult than in a similar work of pure science. Here the knowledge and lact of the editor are especially called into play. Prof. Thorpe has, I think, thosen well, but here and there some pages are taken up with matters of which I should be glad to learn the present industrial value—for in the future all may have a use. Thus I find close together the following: eladic acid, ericolin, reuce acid, erythor—lall, doubless, compounds of scientific interest, but hardly, I would venture to suggest, of industrial importance.

As I said of the first volume, so I may say of the second—that it does credit to the authors of the articles, to the editor, and to the public-spirited publishers. It is good that English scientific literature keeps up its pressige for thoroughness, clearness, and conciseness, and that in this volume of the dictionary no falling off from this standard is visible. H. E. ROSCOE

NO. 1134, VOL. 44

THE FISHES OF SWITZERLAND.

Faune des Vertibrés de la Suisse Par Victor Fatio. Vol V. "Histoire naturelle des Poissons." 2me partie, avec 4 planches, pp. 576 Supplémens, pp. 13. (Genève et Bale H Georg, 1890)

A S more than eight years have elapsed since the publication of the last volume of the "Faune des Vertébrés de la Suisse," I may preface this notice with a few words as to the general scope and progress of this important work. The first volume, published in the year 1859, was devoted to a detailed account of the Mammais of Switzerfand; the third (1872) to the Reptiles and Batrachians, and the fourth (1882) to a part of the Fishes (Acanthotery gians and Cyprinoids), the second volume, which will contain the Birds, being still in course of preparation

The part now published, which is the fifth of the series, treats of the remaining half of the fishes, notably the Salmonoids, which take up nearly two-thirds of the volume, and whose study has probably occupied the author by far the better half of the eight years which he has devoted to its preparation

As regards the plan of the work, the thoroughness and originality with which the author treats his subject, and the fairness of his criticism of his predecessors, I may be allowed to refer to what I have said in my notice of the first volume of the Swiss ichthyology (NATURE, vol zxvii p 220); stating again that "this work rises far above the level of a local publication, and is of as great value to the student of European freshwater fishes as to the Swiss naturalist."

The species treated of in the present volume are the following. 3 loaches, 2 shad, 8 Coregon, 1 grayling, 1 saimon, 1 trout, 1 char, 1 pike, 1 Silurus, 1 eel, 1 burbot, 1 sturgeon, 3 lampreys These bring the total number of Swiss freshwater fishes to 51

The hydrographic system of Switzerland comprises the head-waters of four rivers, viz. the Rhine, Rhone, Po. and Danube. The first contributes the largest contingent to the Swiss fish fauna, viz 42 species; however, this number is reduced to 28 in the upper course of the river. above the falls of Schaffhausen At an altitude of between 600 and 900 m. the majority of the Cyprinoids, and between 1000 and 1100 m the perch, salmon, eel, and burbot disappear Only five species remain at that altitude, viz the miller's thumb, minnow, loach (N barbatulus), grayling, and trout-species which likewise have the greatest horizontal range in a northward direction Between 1800 and 1900 m, first the grayling and the loach are lost, and then successively the trout, miller's thumb, and minnow The trout, however, can still subsist in lakes up to 2630 m, into which this fish has been introduced. The Rhine contributes five types of fishes to the Swiss fauna which are not found in the other hydrographic systems, viz Acerina (the pope), Rhodeus, the salmon, the sea lamprey, and the stickleback. absence in the southern and eastern waters of the four first is readily accounted for by their distribution generally; but it seems very singular that a fish like the stickleback, which in the west of Europe extends far southwards, and reaches even Algeria, and which is supposed to be capable of easy transportation by aquatic birds, should not have made its way into the other riversystems.

The fishes contributed by the Rhone fall into two categories—one comprising those of the part of the River Doubs which is within the political boundaries of Switzerland; the other including the species of the Rhone proper above the "Perte." The latter are computed to be 20 in number, and do not call for special remarks.

The fishes of the Po show a marked difference from those of the Rhine and Rhone. This system is represented in Switzerland by the tributary Ticino, into which is specified in Switzerland by the tributary Ticino, into which the fishes of the Po, used to a warmer climate, avoid not ascending into the cold waters from the Alps, and M. Falio observes, also, that generally these southern fish do not ascend to the same high altitudes as those of the Rhine Eight of the Ticino species are strangers to the rest of Switzerland, vir. a goby (Gobius), which has ascended from the sea; five Cyprinoids, which has ascended from the sea; five Cyprinoids, which has be regarded as southern representatives of northern forms; Cobbits towar and Aloss finite.

Of the 68 species belonging to the fauna of the Danube, only four find their way into Switzerland through the River Inn, viz the iniller's thumb, minnow, grayling, and trout. This is owing to the great elevation of this river at its entrance into the country (1000 metres)

Ichthyologists will turn with particular interest to that part of the volume which contains Dr. Fatio's views on, and his treatment of, the Salmonids; for my own part. I could not help feeling some surprise at what appears to me a somewhat inconsistent mode of dealing with this subject. Whilst the author distinguishes not less than eight Swiss forms worthy of binominal designation in the genus Coregonus, he admits, besides one species of char (Salmo umbla), two equivalent forms only in the genus Salmo, viz the salmon and the trout, for which latter the collective term Salmo lacustris is chosen. If a student of the European fauna, or any part of it. arrives at the conclusion that the various forms of river, lake, and sea trout cannot, and should not, be held to be deserving of specific distinction, no one will deny that there are very strong arguments in favour of this view. In my own experience it does not seem to be desirable to adopt that course - first, because there are certain well characterized and well localized forms which the practical fisherman will always distinguish, and of which the naturalist has, somehow, to take notice; and, secondly, because the ichthyologist who goes beyond the narrow limits of a fauna, and has to deal with the trout of the whole northern hemisphere, is compelled by technical considerations to admit those distinctions. I myself go a step further, and consider it a mistake not to separate, specifically, from the extremely variable Salmo farso, such strongly differentiated forms as Salmo lemanus, S. marsitu. S. venernensis, or the Loch Leven trout of the older authors But if, as is Dr. Fatio's opinion, no taxonomic value is to be assigned to the characters by which those forms of trout are differentiated, then I cannot see why in Coregonus, a closely related genus of the same geological age and distribution, similar organic modifications should be considered to have a different bearing

As is well known, there are some very obscure facts in the life-history of Salmonoids which greatly contribute to the difficulties of their study. Dr. Faito discusses them very fully, but we must pass over the deductions he draws from them, with the exception of the phenomenon of sternity as a cause of change in the outward appearance of a fish. Sternity among Salmonoids is apparently much more common in Switzerland than in British waters; but ever since Sebold lias drawn attention to it, its effects seem to me to have been exaggerated. At any rate, I have received specimens as, and, indeed, with all the outward characters of, the so-called sterile trout of Lake Constance, which had fully matured ova.

Like errata, appendices of works are only too often overlooked, I would therefore mention that the present volume concludes with important supplements to those which contain the Mammalia and Repitlia

The volume is illustrated with four plates—one representing the *Bondelle* of the Lake of Neufchâtel, the others various details of structure, chiefly of Salmonoids

I trust that before many years Dr Fatio will be able to complete his work, for which, not only his countrymen, but every student of the European fauna, owe him a debt of gratitude ALBERT GUNTHER

THE HISTORY OF MARRIAGE.

The History of Human Marriage By Edward Westermarck (London, Macmillan and Co., 1891)

BY "history" our author means "natural history" (p. 19), and his reason for using the odd term "human marriage" is that "marriage, in the natural history sense of the term, does not belong exclusively to our species" (p 6) According to him, "marriage is nothing else than a more or less durable connection between male and female, lasting beyond the mere act of propagation till after the birth of the offspring." In this sense marriage is " an almost universal institution among birds," and "occurs as a rule among the monkeys, especially the anthropomorphous ages, as well as in the races of men" (p 20). Among mankind it is universal, and in all probability is "an inheritance from some ape-like progenitor" (p 538). In this book, therefore, marriage is taken to mean what ordinary people call "pairing, and the professed subject of the volume is the natural history of the habit of pairing in the human race. But surely, on any proper use of terms, marriage is not simple pairing, but such pairing as is protected and regulated by law, or by the public opinion which in rude societies stands for law And the history of an institution which is controlled by public opinion and regulated by law is not natural history. The true history of marriage begins where the natural history of pairing ends

Mr. Westermarck's definition leads him to go at length into various topics that really belong to natural history, but have hitle or nothing to do with the history of marriage in the ordinary sense of the word, such as sexual selection, and the means used by one sex to attract the other. But he also deals with polyandry, kinship through females only, infanticide, exogamy—diof which belong to the sphere of law and custom, within which his definition of marriage is totally inapplicable. To treat these topics as essentially a part of the natural history of

pairing involves a tacit assumption that the laws of society are at bottom mere formulated instincts; and this assumption really underlies all our author's theories. His fundamental position compels him, 'he will be consistent with himself, to hold that every institution connected with marriage that has universal validity, or forms an integral part of the main line of development, is rooted in instinct, and that institutions which are not based on instinct are necessarily exceptional, and unimportant for scientific history. One does not expect a catcit assumption to be carried out with perfect consistency, but, on the whole, Mr. Westermarck's results correspond with his assumption, and have no evidence to satisfy anyone that is not prepared to share the assumption with him.

To show this at length would exceed the limits of a short review; let us, however, take, as a crucial test, Mr Westermirck's explanation of the origin of exogamy. He believes that exogamy and all laws of incest originate in instinctive aversion to sexual interconsists between persons living closely together from early youth (p 330), and the origin of this instinct he explains as follows. He thinks it can be proved that consanguineous marriages are detrimental to the species. Now,

"among the ancestors of man, as among other animals, there was, no doubt, a time when blood-relationship was no bar to sexual intercourse. But variations, here as elsewhere, would naturally present themselves, and those of our ancestors who avoided im-and-in breeding would survey, while the others would gradually decay and ultimately perish. This an instinct would be developed which would be powerful enough, as a rule, to prevent injurious unions. Of course, it would display itself with others with whom they tived, but these, as a matter of fact, would be blood relations, so that the result would be survival of the fitter if no 523.

The obvious and fatal objection to this theory is that it postulates the evisience of groups which through many generations (for the survival of the fittest implies this) avoided wiving within the group. And this is, in fact, a well-established custom of ecogamy, so that the theory begins by postulating the very custom that it professes to explain. Moreover, it is questionable whether Mr. Westermarck's theory even helps to explain the wide diffusion of evogamy. For where wiving outside the local group is the rule, all neighbouring groups mingle their bloods, and consanguineous marriages are not escaped.

It is not surprising that Mr Westermarck, with his habit of looking at the whole subject from a biological point of view, should have little sympathy with the speculations of a man like McLennan, to whom marrage is not a mere fact of natural history, but a relationship resting on contract and approved by custom or law, and who in all his investigations gives weight to the action of human intelligence as the decisive factor in social progress. But it is a pity that this lack of sympathy has sometimes prevented our author from appreciating the full scope of McLennan's methods and arguments. What is said about the Levirate at pp 510-14 could not have been written if Mr. Westermarck had carefully read the discussion of the subject in "The Patriarchal Theory";

have made the error of confounding the Hindu Levirate with the Nyoga (p. 144, note). And here I may also note that the criticism of McLennan's views of exogainy does not take account of the posthumous and very important paper published in the English Historical Review for January 1888.

These are details what is more to be regretted is that Mr. Westermarck has not learned, as he might have done from McLennan, a sounder method of handling the evidence drawn from the usages of rude societies The very possibility of reconstructing the history of human progress rests on the fact that all over the world mankind has been moving in the same general direction, but at very various rates, and that careful reasoning, aided especially by the observation of cases which exhibit a state of transition (eg from one type of kinship to another), enables us to bring out the order in which the various observed types of social structure succeed one another Of all this, Mr Westermarck does not seem to have the least idea. He collects facts about the prevalence of kinship through males or through females, about forbidden degrees, and so forth, without ever rising to the conception that the evidence is good for anything more than an inductio per enumerationem simplicem not the way in which real progress can be made

W ROBERTSON SMITH

OUR BOOK SHELF.

Geological Majo of Monte Somma and Tenurus Constructed by II. J. Johnston-Lurs, M. D. M. R. C. S. B. els-Sc, F. G. S., &c., during the Years 1880-88 Scale, I. 10,000 (63) miches = 1 mile! In Six Sheets, with a Pamphlet criticle "A Short and Concise Account of the Eruptive Phenomena and Geology of Monte Somma and Vesuvius" (London George Philip and Son, 1891)

DUAING the latter half of last century, the changes taking place in Vesuvius were carefully studied and fathfully chronicled by an English diplomatist—Sir William Hamilton, in the closing years of the present century, the control of the control o

In his general memor on the geology of Somma and Vesuvisi, the author has divided the time covered by the history of the volcano into four "sras," and these again into eight "phase," while some of the latter are subdivided into "iperiods". In colouring the map, it has, of course, not been found possible to give expression to anything like such a minute classification of the rocks composing the mountain as is implied in such a scheme. The legend on the map recognizes as the great landmarks in the past that the property of the proposition of the past of

publication. Dr Johnston-Lavis has added one more to the long list of valuable services which he has rendered

to geological science Les Sciences Naturelles et l'Éducation Par T H. Huxley.

Édition Française (Paris Baillière et Fils, 1891) THIS is a translation of various essays with which all English students of Prof Huxley's writings have long been familiar Most of them deal with various aspects of the question as to the true place of science in a proper system of education , and no one who has read them in their original form is likely to have forgotten the philosophical power with which the subject is discussed or the admirable lucidity, strength, and grace of the writer's style With his educational papers Prof Huxley has associated his well-known essays on Descartes and Auguste Comte, which cannot fail to be of interest to French readers. He contributes to the volume a short preface, in which he refers with satisfaction to the astonishing advance that has been made in the recognition of science as an instrument of education He warns men of the younger generation, however, that the battle has only been half won, and that much serious work will have to be done to secure the triumph of the principles for which he has contended Of the translation it may be enough to say that Prof. Huxley cordially commends it as a faithful rendering of his thought.

LETTERS TO THE EDITOR

(The Edutor does not hold himself responsible for opinions ex-pressed by his correspondents. Nisther can be undertake pressed by his correspondents. presses by his correspondence. Centure team of months and to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No noisce is taken of anonymous communications 1

W. E Weber

In the article on Wilhelm Weber (NATURE, July 9, p. 229) no mention is made of the fact that Weber and Gauss in 1833 invented and constructed a telegraph connecting the Physical Laboratory of the University in Gottingen with the Observatory In Germany they are for this reason said to be the inventors of telegraphy. This is, to say the least, a somewhat sweeping statement, as the possibility of communicating by electricity was statement, as the possibility of communicating by electricity was whether and Gots played some just in introducing being that into practice. For my just 1 consider the purely scientific work of either of the two min more glottous. For the corrosion practical consequences of telegraphy have nothing to do with the scientific ment of the invention. Nevertheless 1 thack that an article on Wilhelm Weber would not be complete without entering into this subject
Hanover, Technische Hochschule, July 13 C RUNGS

[Conducting wires were erected between the Gottingen Conducting wires were erected between the Gottingen Observatory and the Physical Cabinet of the University, distant about three quarters of an hinghish mile, in order to obtain accurate comparisons of the clocks. But, in addition to systematic daily transmission of time, the wires were from the first forestending the clocks of the control of the con frequently used for telegraphic purposes, though, with the first arrangements, only two letters could be sent in a minute—G C. F 1

Earthquake Shocks in Italy and Australia.

By a telegram from London, which appeared in the newspapers here on the 12th and 13th inst, information is given of a severe earthquake in Italy (about Vesuvius) on June 7 (Sunday). On that day, several distinct and well marked shocks were felt over parts of the south of Australia, and as there may be some connection between these seismic disturbances in both hemispheres, I give below the times and other information of the disturbances experienced here.

None of the disturbances reported in Australia seem to have been more than a "shake" or share tremor sufficient to shake windows and rattle crockery, &c., but they were enough, in some instances, to produce feelings of nausea

NO. 1134, VOL. 441

June 7, at 2 5 p m, the first disturbance occurred, and was felt all around Melbourne and over a surrounding area of 360 square miles.

June 7, at 2 45, another shake (not so great as the first) was o felt : in this case it was felt most severely to the east of Melbourne

June 7, at 7 20, smart shock felt at Kapunda, South Australia. June 7, at 6 45, slight shock felt at Stockport, South ustralia. The direction of motion is vanously given as from north west to south east, south east to north-west, and south-west to north-east, north to south, south to north, &c. The conclusion arrived at is that the wave was from south to north nearly. The approximate geographical positions of the several

	Lat	Long
Stockport Kapunda	34 21 S. 34 21 S	138 57 E. 138 46 E
Melbourne	37 50 S.	144 58 E.
Melbourne, June 15		R L. J. ELLERY.

P.S -It is quite probable the shocks felt at Kapunda and Stockport were one and the same, as time is not very strictly kept in districts distant from large towns in Australia,

Force and Determinism.

I see nothing to criticise in Mr. Dixon's middle paragraph, wherein he accurately summarizes some of the definitions of mechanics, every that I should prefer to express the menuing of his last sentence by saying that, if in any department something simulated the functions of, say, energy, without obeying its precise mechanical laws, then the distinction between energy and that stomething should be clearly recognized, and another name be given to it.

I find it rather common for "life" to be thought of and classed under the head energy, either by the use of a phrase such as "vital energy," or in a more direct way, the reason being apparently that organisms while living simulate some of the apparently that Organisms when Irving simulate some of the functions of energy, and cease to do so when dead It was against this confusion that I wrote on p 401 (vol xlin.)

Life has not yet been included in the domain of physics, neither has it, so far as I am aware, been much studied under

the head biology.

And yet the disturbing action of live animals will have to be formulated and attended to some day, even in physics, for, though they generate no energy nor affect its amount in the slightest degree, they certainly control it and direct it in channels it would not otherwise have taken. The question is, How do they manage this? And one answer that may be given is, By exerting

manage this? And one answer that may be given is, By exerting directive or guiding forces on matter.

Of course they are not limited to this, but in so far as they do work their action is fairly understood—the energy displayed by a gang of navives is known to be derived from the little tin cans. they bring with them. the energy is not their shut their victuals', they simply direct it. But how comes it that they can direct the energy of victuals and atmosphere into the erection of the precise bridge or other structure which has been planned? What determines the direction of the transfer of energy?

The same question may doubtless be asked in connection with inanimate activity · I would not be understood as assuming for certain any clear or essential difference between the two cases . but in neither case do I know the answer

The action of force in doing work, se transferring and transforming quantities of energy, has been thoroughly attended to
The action of force in directing and guiding the transfer of
matter and energy does not seem to me to have been seriously contemplated

In his most recent book ("The Philosophical Basis of Lvolution") Dr. Croll attacks the problem, and says that guidance is effected by "determinism" not by force. But that cannot be admitted; for without force the motion of matter cannot be changed in direction any more than in speed. Force is certainly necessary to direct the motion of matter, it is energy only which is unnecessary; for any transfer of energy that may occur is an accidental, not an essential, concomitant.

I determine to move an object: it may be only my finger, or it may be a wheelbarrow In so far as I do any work in the action I do so at the expense of my food, and there is nothing but a chemical difficulty about that The mystery begins when one caks how I manage to direct that energy along a definite path so as to produce a willed result. The only answer I know is, "by a nervous implies libraried from brain centres." But what is it that is thus liberated? and what pulls the trigger to liberate it? By mechanical analogy one would say that energy can only be guided by force, and that force must therefore be exerted as the brain celler; but, if so, the relation between force, which is a

mechanical thing, and will or life, or whatever it is, which is a

psychological thing, demands investigation
I trust that Mr Lloyd Morgan will help me to get my ideas
on these subjects straighter, and will point out if I have made any assertions which are obviously erroneous or grotesque. The borderland of psychology and physics is the last place in which I would like to dogmatize, and in a letter like this I see no harm though the to augmente, and in a section that the interior in airing confessedly immature and groping notions, in the hope that ventilation may clear the air. So far as physics only is concerned. I have stated how I regard the phrase "expenditure of tent ventuation may clear the air So are as physics, cerned, I have stated how I regard the phrase "expenency" in the Philosophical Magazine for June 1885

With regard to the crux raised in Mr Dixon's last paragraph, that nothing but matter can exert force, because the acting matter that nothing but matter can exert force, because the exting matter must receive an equal opposite momentum, it may perhaps be just worth noticing that an infinite mass can absorb any amount of momentum without receiving a trace of energy or being itself in any way affected. OLIVIR J LODGS.

Liquid Prisms

I OBSERVE in NATURE of July 2 (p 207), that it is stated Herr Wolter has recently recommended a monobromnaphthalene as a substance peculiarly fitted for study of the ultra violet part of the spectrum, by reason of its high dispersive power and trans-parency for the ultra-violet rays.

pareincy for the ultra-voict rays.

Perhaps I may be permitted to state that Mr Madan published an account of 1st diagention and refractive power in the inheritance of the diagention and refractive power in the made use of many other whataness, including methy salicylate, I gave this a trial. For ordinary work it would be excellent of Coolurles, but unfortunately, no matter how free from colours it may be when freshly prepared, long-continued use causes at to become yellow, and in considerable thicknesses even dark bowen For the ultra-violet rays it is undoubtedly better than carbon disulphide, but nevertheless tractically useless, as the line N, which it is said to transmit, has a wave-length of 3580, so that only about one half of the ultra-violet solar rays are observable with it. In metallic spectra almost all lines of interest he between 3580 and 2000 A liquid which I considered to possess oetween 3300 and 2000. A figuid which I considered to possess much superior optical properties is mexister methods, it is perfectly colourless, and of such density that fliot glass will float upon it. When the glass is immersed it becomes unvisible, consequently the refraction and dispersion of the liquid are probably seceptionally high. As far as I can recollect, being without access to my notes, a thickness of 50 millimetres freely transmitted all rays to about \$\lambda\$ 2000—that is to say, the entire solar spectrum Unfortunately, it has its drawbacks, in being somewhat volatile, and its vapour highly poisonous
Stonehaven, N.B.
W. N. HARLIFY.

The Identification of Templeton's British Earthworms

BETWEEN the years 1829 and 1836 the first series of Loudon's Magazine of National Missions appeared in mine volumes. In the last volume we find some notes on earthworms by Templeton, which have proved somewhat puzzling to students of more recent times. I have been fortunate enough to follow Templeton in some of his researches, and am able to correct and verify certain

of his statements

of his statements. The Lumbreus vanihurus, Temp (op. cst., 1x 235), is the angler's gilt tail, and as such is synonymous with Jumbreus pater, Hoffm., and Dendrobena Beedest, Elem. Lumbreus gardnams, Temp. (be cst.), is undoubtedly the mucous worm (Allelolophone mucous, Etend, or one of its near alize, all of which are to be found of a pale rosy colour coiled up into a knot at certain times of the year.

It is to Lumbricus ontilurus (= Omilurus rubescens, Temp., lo 13.) however, that I wish to direct special attention Grube, in 1851 ("Familien der Anneliden," p. 101), placed it, with Templem of the Ormon, in a list of species which were insufficiently characterized for systematic parposes. Vejdowick, in 1884 ("System and Morph, der Oligochwein," p. 63), places it among

the questionable species without note or comment, and, so far as can gather, no one has been able to throw light upon it since Templeton says the worm is never larger than half the size of

Templeton says the worm is never larger than hall the size of \$L\$ terrettrs, \$L_1\$ to \$a\$ bught reddish brown, with the tail very flat, and the body unfurnished with a belt at the position of the serval organs. It would be very easy to suppise from this somewhat wague account that the writer had only seen immature specimens; but a little careful study of his words shows that he Specimens; out a fifte careful study of his words shows that he knew what he was writing, and that his worms were mature. Now a mature species of *Lumbricus* without a chiellum is certainly an anomaly, and needs investigation

While collecting Annelids recently, I came across half a dozen specimens which at first sight exactly resembled Lumbricus rubellue, Hoffin I took them home for verification, and infinediately observed the difference I had obtained with them typical specimens of rubdius, which enabled me to make a careful com-

specimens of violents, which established in to make a careful com-parison of the two species in a living state.

The following is a description of the worm as I wrote it down before observed in the control of the control of the con-being dependent of the control of the control of the becoming lighter towards the posterior extremity, which is flesh-benous grapher towards the posterior extremity, which is fleshcoloured or light red, pink ventrally Prostomium dovetailing completely into the peristomium, and posses ing a transverse groove in the middle, as snown in the accompanying sketch



Lumbricus rulescent Segments 1 to 3 with prostomium entirely cutting the first segment or peristomium

Segments not annulated (or divided by transverse rings) Length about 3 inches, total number of segments about 120 Setæ in couples as in typical Lumbricus. Male or spermiducal pores on segment 15 with papillae, which, however, do not extend over the neighbouring segments. Body cylindrical in front, flattened posteriorly. The dorsal pore between 5 and front, flattened posteriorly. The dorsal pore between 5 an 6. It appeared at first between 7 and 8, but by usin polarized light on the cuticle, when spread on a glass slip it whole series of pores in one or two specimens became clearly visible from the fifth segment backwards

value from the fifth segment backwards.

On the wentral surface prominent papilæ appeared on segments 28 and 29, such as are often seen on typical L agreeda, 10.6fm. Now came the crucial question, I st there no clinellum? By studying all the examples carefully, I found that they agreed in one particular. The segments 34 to 39 differed in structure from the rest on the dorsal surface. On the under surface from 33 to 40 were differentiated, and showel a glandular structure, while the band representing the tubercula pubertaits extended

distinctly along the ventral surface of 35, 36, 37, 38

This description of the external characters shows the worm to be a decided Lumbreux, tested by Dr Benham's definition in 'An Attempt to Classify Earthworms', but it differs from every one of our British species, especially in the backward position and inconspictions nature of the clitellum I am unable to refer it definitely to any of the European species, and propose that for the present it should be known as Lumbricus rubescens (Temp), thus retaining the two names from Templeton's synonyms which are most appropriate to what I regard as the species intended by him
I may add that I have recently found one or two other earth-

worms in Yorkshire which have not yet been recorded as British, and will form interesting additions to our Annelid fauna Idle, near Bradford, July 15 Ilii DERIC F

HILDERIC FRIEND

Copepoda as an Article of Food

DURING recent years a good deal has been aid amongst marine zoologists of the use, as a food supply, that might be made of the enormous numbers of Copepoda that swarm in the surface-waters of the sea, and the Prince of Monaco has pointed out the value this widely distributed nutritious matter might have to shipwrecked sailors, but I am not aware that anyone has yet actually made the experiment of cooking and eating Copepoda, so the following record may be of some interest. While townetting during the last few days about the North Cape, we have had some large hauls of Copepoda, and it coccurred to a least ingit, while watching the middight sam off of the control of the same part of the same part of from the preserving bottle sad devoted to the succepan we put out one of the similar towners (3) feet long, mouth 1 fout in diameter) from 11 so p.m. to midnight, the ship going dead slow, and treversing in all large of the same part of minutes with butter, salt, and pepper, poured it into a dish, covered it with a thin layer of melied butter, set it in ice to cool and stiffen, had it this morning for breakfast on thin breadcool and stiffen, had it this morning for break fast on thus bread and butter, and Goand it most excellent. The states is less procool and the state of two of sea made, when cooked in butter, a dishell which
was shared by eight people, and would probably have formed,
with batten to break, a nour-bang mend for one person. It
quantities, which might be preserved in time of dables, like
by the state of the potted shrimps S 1 Argo, Tromso, Norway, July 13

Are Seedlings of Hemerocallis fulva specially Variable?

I SHALL be grateful to any of your readers who will write and terr experiences as to the variability of seedlings of Hemerocaliss fulva, or who will raise it from seed in fair quanti and kindly communicate to me their results, which shall be duly acknowledged

My reason is this there is in the formation of the police in this plant a peculiarity which, according to Weismann's views, should lead to excessional variability in the secilings, but, so

Royal University, Dublin, July 9

The Green Sandpiper

On Sunday last, July 12, I saw flying round a large pool in Essex, a specimen of the green sandpiper. It flew leisurely round the pool, and seemed as if it were not far from its summer home. I think, therefore, that the bird must be nesting in the

county, and probably in the neighbourhood

Can any of your correspondents inform me whether the nest
has been found anywhere, in recent years, in England? ARGVII.

Argyll Lodge, Kensington, July 17

LIQUIDS AND GASES!

A LMOST exactly twenty years ago, on June 2, 1871, Dr Andrews, of Belfast, delivered a lecture to the members of the Royal Institution in this hall, on "The Continuity of the Gaseous and the Liquid States of Matter" He showed in that lecture an experiment which I had best describe in his own words -

"Take, for example, a given volume of carbonic acid at 50°C, or at a higher temperature, and expose it to increasing pressure till 150 atmospheres have been reached. In the process, its volume will steadily diminish as the pressure augments, and no sudden diminution of volume, without the application of external pressure, will occur at any stage of it When the full pressure has been applied, let the temperature be allowed to fall, until the carbonic acid has reached the ordinary temperature of the atmosphere During the whole of this operation, no break of continuity has occurred. It begins with a gas, and by a series of gradual changes, presenting nowhere any abrupt alteration of volume, or sudden evolution of heat, it ends with a liquid

1 Lecture delivered by Prof W Ramsay, F.R S, at the Royal Institution Friday, May 3

NO. 1134, VOL. 44]

"For convenience, the process has been divided intotwo stages—the compression of the carbonic acid, and its subsequent cooling But these operations might have been performed simultaneously, if care were taken so to arrange the application of the pressure and the rate of cooling, that the pressure should not be less than 76 atmospheres when the carbonic acid had cooled to 31

I am able, through the kindness of Dr Leits. Dr. Andrews' successor at Belfast, to show you this experiment, with the identical piece of apparatus used on the

occasion of the lecture twenty years ago

I must ask you to spend some time to-night in con-sidering this remarkable behaviour, and, in order to obtain a correct idea of what occurs, it is well to begin with a study of gases, not, as in the case you have just seen, exposed to high pressures, but under pressures not differing greatly from that of the atmosphere, and at temperatures which can be exactly regulated and measured Io many here to-night, such a study is unnecessary, owing to its familiarity, but I will ask such of my audience to excuse me, in order that I may tell my story from the beginning.

Generally speaking, a gas, when compressed, decreases in volume to an amount equal to that by which its pressure is raised, provided its temperature be kept constant. This was discovered by Robert Boyle in 1660, in 1661 he presented to the Royal Society a Latin translation of his book, " Fouching the Spring of the Air and its Effects"

His words are -

"'I's evident, that as common air, when reduced to half its natural extent, obtained a spring about twice as forcible as it had before, so the air, being thus compressed, being further crowded into half this narrow room, obtained a spring as strong again as that it last common air "

To illustrate this, and to show how such relations may be expressed by a curve, I will ask your attention to this model We have a piston, fitting a long horizontal glass tube confines air under the pressure of the atmosphere—that is. some 15 pounds on each square inch of area of the piston The pressure is supposed to be registered by the height of the liquid in the vertical tube. On increasing the volume of the air, so as to double it, the pressure is decreased to of the air, so as to double it, the pressure is because to half its original amount. On decreasing the volume to half its original amount, the pressure is doubled again halving, the pressure is again doubled. Thus you see a curve may be traced, in which the relation of volume to pressure is exhibited Such a curve, it may be remarked

incidentally, is termed an hyperbola

We can repeat Boyle's experiment by pouring meicury into the open limb of this tube containing a measured amount of air, on causing the level of the mercury th the open limb to stand 30 inches (that is, the height of the barometer) higher in the open limb than the closed limb, the pressure of the atmosphere is doubled, and the volume is halved And on trebling the pressure of the atmosphere the volume is reduced to one-third of its original amount, and, on adding other 30 inches of mercury, the volume of the air is now one-quarter of that which it originally occupied

It must be remembered that here the temperature is kept constant; that it is the temperature of the surround-

ing atmosphere
Let us next examine the behaviour of a gas when its temperature is altered, when it becomes hotter This tube contains a gas-air-confined at atmospheric pressure by mercury, in a tube surrounded by a jacket or mantle of glass, and the vapour of boiling water can be blown into the space between the mantle and the tube containing the air, so as to heat the tube to 100', the temperature of the steam The temperature of the room is 17° C., and the gas occupies 290 divisions of the scale. On blowing in steam, the gas expands, and on again equalizing pressure, it stands at 373 divisions of the scale. The gas has thus expanded from 200 to 273 divisions, 7. ets volume has increased by 83 divisions, and the temperature has risen from 17° to 10°, 12° through 83°. This law of the expansion of gases was discovered almost simultaneously the contract of the contract o

We have experimented up to the present with air—
mixture of two gases, oxygen and nitrogen, and the
boling-points of both of these elements he at very thoboling-points of both of these elements he at very the
ordinary atmospheric temperature he a long way above
the boiling-points of liquid oxygen and liquid nitrogen at
the ordinary atmospheric pressure. But it is open to us to
study a gas, which, at the ordinary atmospheric temperature
1 shall choose water-gas in order that it may be a gas at
ordinary atmospheric pressure, however, we must heat it
to a temperature above 100° C, its boiling-point. This
tube contains water-gas at a temperature of 100° C, it
at the same level in both the tubes and in this reservoir,
which communicates with the lower end of the tube by
means of the india-rubber tubing. The temperature
105' is manutaned by the vapour of chlorobenzene, boiling
that of the atmosphere.

Let us now examine the effect of increasing pressure. On raising the reservori, the volume of the gas is dimmished, as usual, and nearly in the ratio given by Boyle's law, that is, the volume decreases in the same proportion as the pressure increases. But a change is soon observed; the pressure soon ceases to rise: the distante hetween the mercury in the reservoir and that in the tube remains constant, and the gas is now condensing to liquid. The pressure continues constant during this change, and to have been decreased in the constant during the change, and in the water gas has condensed to liquid only when all the water gas has condensed to liquid offensed, an enormous increase of pressure is necessary to densed, an enormous increase of pressure is necessary to water scarcely yields to pressure, and in such a tube as this, no measurements could be attempted with success.

Representing this diagrammatically, the right-hand part of the curve is, as before, nearly a hyperbola. Then and the curve is, as before, nearly a hyperbola. Then without rise of pressure, represented by other occurs without rise of pressure, represented by other occurs without rise of pressure, represented by other occurs as in presence of water; the vertical, or nearly vertical line represents the sudden and great rise free the present of water gas as the present of the present of water gas to the present of the present of water gas obtained by the present of the present of water gas obtained by the present of the present of water gas obtained by the present of the gas of of

slight decrease of volume of water produced by a great morerase of pressure. And we should have similar lines for 120°, 130°, 140°, 150°, and for all temperatures within certain limits. Such lines are called isothermal lines, or shortly "isothermals," or lines of equal temperature, and represent the relations of pressure to volume for different temperatures.

different temperatures
Dr Andrews made similar measurements of the relations between the pressures and volumes of carbon
for the pressures and volumes of carbon
shown you for water. But I briefer in speak to you
about similar results obtained by I'rof Sydney Young
and myself with ether, because DI Andrews was unable
to work with carbon dioxide free from air, and that infleeneed his results. For example, you see that the
meeting-points of his hyperbolic curves with the straight
is caused by the presence of about 1 part of air in 500
parts of carbon douded, also the condenstroin of gas
accompany of the presence of about 1 part of air in 500
parts of carbon douded, also the condenstroin of gas
change from a mature of liquid and gas to liquid
when were more easily able to fill a tube with ether
free from air, and you will notice that the points I have
referred to are angles, not curves

Let me first direct your attention to the shapes of the curves in the diagram. As the temperature rises, the apour-pressure lines les at higher and higher pressures, and the lines themselves become shorter and shorter. And finally, at the temperature 31° for carbon dioxide, and at 193° for ether, there ceases to be a horizontal at one control of the state of the stat

When a gas is compressed, it is heated Work is done on the gas, and its emperature rises If I compress the air in this syringe forcibly, its temperature rises so high that I can set a piece of indeer on fire, and by its help explode a little gunpowder. If the ether at its critical point be compressed by screwing in the screw, it is somewhat warmed, and the blue cloud disappears. Conversely, increasing its volume, it is cooled, and a dense must is seen, accompanied by a shower of either rain. This is seen as a black fog on the screw.

I wish also to direct your attention to what happens if the volume given to the ether is greater than the critical volume—on increasing the volume, you see that it boils away and evaporates completely, and also what happens if the volume be somewhat less than the critical volume it then expands as liquid, and completely fills the tube. It is only at the critical volume and temperature that the pressure. If the volume be too great, the pressure is below the critical pressure; if too small, the pressure is hugher than the critical pressure.

Still one more point before we dismiss this experiment. At a temperature some degrees below the critical temperature, the mensions, e. the surface of the liquid, is curved. It has a skin on its surface; its molecules, as Lord Rayleigh has recently explained in this room, attract one another, and It exhibits surface-tension. Raise the temperature, and the mensious grows flatter, raise it further, and it is nearly flat, and almost invisible; at the critical temperature it disappears, having first become quite flat surface-tension, therefore, disappears at the critical point.

A liquid would no longer rise in a narrow capillary tube; it would stand at the same level outside and inside

It was suggested by Prof James Thomson, and by Prof Classuss about the same time, that if the sideal state of things were to exist, the passage from the liquid to the gaseous state should be a continuous one, not merely at and above the entical point, but below that temperature and the suggested that the curves, shown in the figure, and the suggested that the curves, shown in the figure, pressure, should continue sinuously. Let us see what this conception would involve.

On decreasing the volume of a gas, it should not liquefy at the point marked B on the diagram, but should



still decrease in volume on increase of pressure. This decrease should continue until the point E is reached. The anomalous state of matters should then occur, that a decrease in volume should be accompanied by a decrease of pressure. In order to lessen volume, the gas must be exposed to a continually diminishing pressure. But standard is of its nature unstable, and has a contain part of the standard in the curve is continuous with the realizable curve representing the compression of the lound, about the standard in the

compression of the loquid, above D
Dr. Sydney Young and I succeeded, by a method which
I shall briefly describe, in mapping the actual position
of the unrealizable portions of the curve They have the

NO. 1134, VOL. 44

form pictured in this figure. The rise from the gaseous state is a gradual one, but the fall from the liquid state is abrupt.

Consider the volume 14 cubic centimetres per gram on the figure. The equi-volume vertical line cus the isothermal lines for the temperatures 175, 1867, 1857, 1007, and so on, at certain definite pressures, which may be read course of times of equal volume, of which the instance given is one, using temperatures as ordinates and pressures as abscissas. We can thus find the relations of temperature to pressure for certain definite interactions of times and the read of the control of the simplest pressure is a linear function of temperature. Expressed

$$p = bt - a$$

where h and a are constants, depending on the volume. Checken, and waying with each volume. But a straight line may be extrapolated without error, and to, having found values for a and h for such a volume as 6 c c per gram, by help of experiments at temperatures higher than 1957, it is possible by extrapolation to obtain the pressures corresponding to temperatures below the critical that the substance at volume 6 is in practice partly liquid and partly gas. Yet it is possible by such means to ascertain the relations of pressure to temperature for the unrealizable portion of the state of a liquid—that is, we can deduce the pressures and temperature corresponding to a manner the thange from liquid on gas. And in this manner the amounts have on the figure have been constructed.

It is possible to realize experimentally certain portions of such continuous curves. If we condense all gaseous ethers, and, when the tube is completely filled with liquid, either and, when the tube is completely filled with liquid to the considerably below the vapour pressure corresponding to the temperature of ebullition, without any change further tendercon of pressure—an expansion too small to be seen reduction of pressure—an expansion too small to be seen pressure, such expension of the control of the liquid suddenly changes into gas, while the pressure rises quickly to the yapour-pressure corresponding to the temperature. If we are successful in expelling all air or gas of the control of the curve can be experimentally vasibled.

of this curve can be experimentally realized. The first notice of this appearance, or rather of one owing its existence to a precisely similar cause, is due to thooke, the celebrated contemporary of Boyle. It is noted in the account of the proceedings of the Royal Society on November 6, 1672, Ital. "Mr. Hooke read a discourse of his, containing his thoughts of the experiment of the young of the containing his thoughts of the experiment specified by inches, together with some experiments made by him, in order to determine the cause of this strange phenomenn. He was ordered to prepare those experiments for the view of the Society." And on November 13 "the experiment for the view of the Society." And on November 13 "the experiment for the high suspension of quicksliver being called for, it was found that it had failed. It was ordered to hat thinker glasses should be provided for the next

There can be no doubt that this behaviour is caused by the attraction of the molecules of the liquid for each other. And if the temperature be sufficiently low, the pressure may be so reduced that it becomes negative—that is, until the liquid is exposed to a strain or pull, as is the mercury. This has been experimentally realized by M Berthelot and by Mr. Worthington, the latter of whom has succeeded in straining alcohol at the ordinary tem-

perature with a pull equivalent to a negative pressure of 25 atmospheres, by completely filling a bulb with alcohol, and then cooling it The alcohol in contracting strains the bulb inwards, and finally, when the tension becomes very great, parts from the glass with a

sharp " click '

To realize a portion of the other bend of the curve, an experiment has been devised by Mr. John Aitken. It is as follows.—If air—that is, space, for the air plays a secondary part—saturated with moisture be cooled, the moisture will not deposit unless there are dust-particles mousture will not deposit unless there are dust-particles on which condensation can take place. It is not at first evident how this corresponds to the compressing of a gas without condensation. But a glance at the figure will render the matter plain. Consider the isothermal 175° for ether, at the point marked A If it were possible to lower the temperature to 160°, without condensation, keeping volume constant, pressure would fall, and the gas would then be in the state represented on the isothermal line at G that is, it would be in the same condition as if it had been compressed without condensation

You saw that a gas, or a liquid, is heated by com-pression; a piece of tinder was set on fire by the heat evolved on compressing air. You saw that condensation of ether was brought about by diminution of pressure— that is, it was cooled. Now, if air be suddenly expanded, it will do work against atmospheric pressure, and will cool itself. This globe contains air, but the air has been filtered carefully through cotton-wool, with the object of excluding dust-particles. It is saturated with object or excituding dust-particles at its saturated with moisture. On taking a stroke of the pump, so as to exhaust the air in the globe, no change is evident; no condensation has occurred, although the air has been so cooled that the moisture should condense, were it possible
On repeating the operation with the same globe, after
admitting dusty air—ordinary air from this room—a slight fog is produced, and, owing to the light behind, a circular rainbow is seen, a slight shower of rain has taken place There are comparatively few dust particles, taken piace Inere are comparatively tew dust particles, because only a little dusty air has been admitted. On again repeating, the fog is denser, there are more particles on which mosture may condense.

One point more, and I have done. Work is measured.

by the distance or height through which a weight can be raised against the force of gravity. The British unit of work is a foot-pound-that is, a pound raised through one foot; that of the metric system is one gram raised through one centimetre. If a pound be raised through two feet, one centimetre. It a pound be raised through two test, wice as much work is done as that of raising a pound through one foot, and an amount equal to that of raising two pounds through one foot. The measure of work is therefore the weight multiplied by the distance through which it is raised. When a gas expands against pressure, it does work The gas may be supposed to be confined in a vertical tube, and to propel a piston upwards, against the pressure of the atmosphere. If such a tube has a sectional area of one square centimetre, the gas in expanding a centimetre up the tube lifts a weight of nearly loop grams through one centimetre; for the pressure of the atmosphere on a square centimetre of surface is nearly 1000 grams—that is, it does 1000 units of work, or nearly 1000 grains—Inst 18, it does 1000 units of work, or ergs. So the work done by a gas in expanding is measured by the change of volume imultiplied by the pressure. On the figure, the change of volume is measured horizontally, the change of pressure vertically. Hence the work done is equivalent to the area. AECD on the figure

If liquid, as it exists at A, change to gas as it exists at B, the substance changes its volume, and may be made to do work. This is familiar in the steam-engine, where work is done by water, expanding to steam and so in-creasing its volume. The pressure does not alter during this change of volume, if sufficient heat be supplied, hence the work done during such a change is given by the rectangular area.

NO. 1134, VOL. 44]

Suppose that a man is conveying a trunk up to the first story of a house, he may do it in two (or, perhaps, a greater number of) ways. He may put a ladder up to the drawing-room window, shoulder his trunk, and deposit the drawing-room window, shoulder his trunk, and deposit it directly on the first floor. Or he may go down the area stairs, pass through the kitchen, up the kitchen stairs, up the first flight, up the second flight, and down again to the first story. The end result is the same; and he does the same amount of work in both cases, so far as conveying the weight to a given height is concerned, because in going down-stairs he has actually allowed work to be done on him, by the descent of the weight.

Now, the liquid in expanding to gas begins at a definite volume, it evaporates gradually to gas without altering pressure, heat being, of course, communicated to it during the change, else it would cool itself: and it finally ends as gas It increases its volume by a definite amount at a definite pressure, and so does a definite amount of work : this work might be utilized in driving an engine

But if it pass continuously from liquid to gas, the But it it pass continuously from induit to gas, the starting-point and the end point are both the same as before. An equal amount of work has been done. But it has been done by going down the area stair, as it were, and over the round I described before.

It is clear that a less amount of work has been done on the left-hand side of the figure than was done before and a greater amount on the right-hand side, and if I have made my meaning clear, you will see that as much less has been done on the one side as more has been done on the other—that is, that the area of the figure BEH must be equal to that of the figure AFH Dr Young and I have tried this experimentally—that is, by measuring the calculated areas, and we found them to be

equal.

This can be shown to you easily by a simple device namely, taking them out and weighing thein. As this diagram is an exact representation of the results of our experiments with ether, the device can be put in practice We can detach these areas which are cut out in tin, and place one in each of this pair of scales, and they balance The fact that a number of areas thus measured gave the theoretical results of itself furnishes a strong support of the justice of the conclusions we drew as regards the forms of these curves

To attempt to explain the reasons of this behaviour would take more time than can be given to-night; moreover, to tell the truth, we do not know them. But we have at least partial knowledge, and we may hope that investigations at present being carried out by Prof. Tait may give us a clear idea of the nature of the matter, and of the forces which act on it, and with which it acts, during the continuous change from gas to liquid

EXPERIMENTAL RESEARCHES ON MECHANICAL FLIGHT

THE following is a translation of a communication made by Prof. S. P. Langley to the Paris Academy of Sciences on July 13 :--

I have been carrying out some researches intimately connected with the subject of mechanical flight, the results of which appear to me to be worthy of attention They will be published shortly in detail in a memoir Meanwhile I wish to state the principal conclusions

In this memoir I do not pretend to develop an art of mechanical flight, but I demonstrate that, with motors having the same weights as those actually constructed, we possess at present the necessary force for sustaining, with very rapid motion, heavy bodies in the air; for example, inclined planes more than a thousand times denser than the medium in which they move.

Further, from the point of view of these experiments and

also of the theory underlying them, it appears to be demonstrated that if, in an acrial movement, we have a plane of determined dimensions and weight, inclined at such or determined dimensions and weight, inclined at such angles and moving with such velocities that it is always exactly sustained in horizontal flight, the more the velocity is augmented the greater is the force necessary to diminish the sustaining power. It follows that there will be increasing economy of force for each augmentation of velocity, up to a certain limit which the experiments have not yet determined. This assertion, which I make here with the brevity necessary in this résumé, calls for a more ample demonstration, and receives it in the memoir that I have mentioned

The experiments which I have made during the last four years have been executed with an apparatus having revolving arms about 20 metres in diameter, put in movement by a 10 horse-power steam-engine They are

chiefly as follows -

(1) To compare the movements of planes or systems of planes, the weights, surface, form, and variable arrangements, the whole being always in a horizontal position, but disposed in such a manner that it could fall freely (2) To determine the work necessary to move such

planes or systems of planes, when they are inclined, and possess velocities sufficient for them to be sustained by the reaction of the air in all the conditions of free horizontal flight. (3) To examine the motions of acrostats provided with

their own motors, and various other analogous questions that I shall not mention here

As a specific example of the first category of experi-ments which have been carried out, let us take a borizontal plane, loaded (by its own weight) with 464 grams, having a length 0.914 metre, a width 0.102 metre, a thickness 2 mm, and a density about 1900 times greater than that of the surrounding air, acted on in the direction of its length by a horizontal force, but able to fall freely
The first line below gives the horizontal velocities in

nietres per second; the second the time that the body took to fall in air from a constant height of 1 22 metres. the time of fall in a vacuum being o 50 second

When the experiment is made under the best conditions it is striking, because, the plane having no inclination, there is no vertical component of apparent pressure to prolong the time of fall; and yet, although the specific gravity is in this more than 1900 times that of the air, and although the body is quite free to fall, it descends very slowly, as if its weight were diminished a great number of times. What is more, the increase in the time of fall is even greater than the acceleration of the lateral movement.

The same plane, under the same conditions, except that it was moved in the direction of its length, gave analogous but much more marked results; and some observations of the same kind have been made in numerous experiments with other planes, and under more varied

conditions

From that which precedes, the general conclusion may be deduced that the time of fall of a given body in air, whatever may be its weight, may be indefinitely pro-longed by lateral motion, and this result indicates the account that ought to be taken of the inertia of air, in acrial locomotion, a property which, if it has not been neglected in this case, has certainly not received up to the present the attention that is due to it By this (and also in consequence of that which follows) we have established the necessity of examining more attentively the practical possibility of an art very admissible in theory

-that of causing heavy and conveniently disposed bodies to slide or, if I may say so, to travel in air.

In order to indicate by another specific example the

nature of the data obtained in the second category of my experiments, I will cite the results found with the same plane, but carrying a weight of 500 grams, that is 5380 grams per square metre, inclined at different angles, and moving in the direction of its length. It is entirely free to rise under the pressure of the air, as in the first example it was free to fall, but when it has left its support, the velocity is regulated in such a manner that it will always be subjected to a horizontal motion

The first column of the following table gives the angle (a) with the horizon, the second the corresponding velocity (V) of blanement-that is, the velocity which is exactly sufficient to sustain the plane in horizontal movement, when the reaction of the air causes it to rise from its support, the third column indicates in grams the resistances to the movement forward for the corresponding velocities -a resistance that is shown by a dynamometer These three columns only contain the data of the same experiment The fourth column shows the product of the values indicated in the second and thirdthat is to say, the work T, in kilogram-metres per second, which has overcome the resistance. Finally, the fifth column, P, designates the weight in kilograms of a system of such planes that a 1 horse-power engine ought to cause to advance horizontally with the velocity V and at the angle of inclination a

	v	R	T = VR	P = 500 × 4554
45	11 2	500	56	68
30	106	275 .	29	130
15	11 2	128	14	26 5
10	12 4	88	1 1	34.8
5	15 2	45	0.7	55.5
2	20 0	20	0.4	95 0

As to the values given in the last column, it is necessary to add that my experiments demonstrate that, in rapid flight, one may suppose such planes to have very small interstices, without diminishing sensibly the power of support of any of them

It is also necessary to remark that the considerable weights given here to the planes have only the object of facilitating the quantitative experiments. I have found that surfaces approximately plane, and weighing ten times less, are sufficiently strong to be employed in flight, such as has been actually obtained, so that in the last case more than 85 kilogiams are disposable for motors and other accessories As a matter of fact, complete motors weighing less than five kilograms per horse-power have recently been constructed

Although I have made use of planes for my quantitative experiments, I do not regard this form of surface as that which gives the best results I think, therefore, that the weights I have given in the last column may be considered as less than those that could be transported with the corresponding velocities, if in free flight one is able to guide the movement in such a manner as to assure horizontal locomotion—an essential condition to the economical employment of the power at our disposal

The execution of these conditions, as of those that

impose the practical necessity of ascending and descend-ing with safety, belongs more to the art of which I have

spoken than to my subject.

The points that I have endeavoured to demonstrate in the memoir in question are:—
(1) That the force requisite to sustain inclined planes in

(1) that the force requisite to sustain inclined planes in horizontal aerial locomotion diminishes, instead of in-creasing, when the velocity is augmented; and that up to very high velocities—a proposition the complete ex-perimental demonstration of which will be given in my memoir; but I hope that its apparent improbability will be diminished by the examination of the preceding

(2) That the work necessary to sustain in high velocity the weights of an apparatus composed of planes and a motor may be produced by motors so light as those that have actually been constructed, provided that care is taken to conveniently direct the apparatus in free flight, with other conclusions of an analogous character

I hope soon to have the honour of submitting a more complete account of the experiments to the Academy

ON THE SOLID AND LIQUID PARTICLES IN CLOUDS 1

I N this paper are given the results of some observations made while on the Rigi in May last, on the solid and liquid particles in clouds. It was noticed, when making observations on the number of dust particles in the atmosphere, that when the top of the mountain was in cloud, the number of particles varied greatly in short intervals, while previous experience had shown that at elevated stations the number was fairly constant for long periods. In order to investigate the case of this want of uniformity in the impurity of clouded air, extreme conditions were selected. and the air tested in cloud and in the clear air outside of When this was done the clouded air was found to have always more dust in it than the air outside Its humidity was of course also greater The relative amount of dust in pure and in clouded air varied greatly Some parts of the cloud had only about double the number of particles there were in the clear air, while in other parts
the proportion was much greater. The best example
tested occurred on the 25th of the month, when there were observed 700 particles per c c in the clear air, while the number in cloud went up to over 3000, and in one cloud to 4200 particles per c. These observations were taken on the top of the mountain while the clouds were passing over it, the readings being taken in the cloud and

again when it had passed and was replaced by clear air. These observations at once showed the cause of the variability in the number of dust-particles in the clouds the dust acted as a kind of ear-mark, and showed that the air forming the clouds was impaire valley air, which impure air had become more or less mixed with the purer upper air. Where little of the impure air had mixed with the upper air, the number of particles was not large, and the clouding slight, but where the valley air was greatly in excess, the number of particles was great, and the cloudexcess, the number of particles was great, and the cloudcess that the control of the control of the conditions in stratus and other clouds may be differed to ditions in stratus and other clouds may be differed for ditions in stratus and other clouds may be differed for ditions in stratus and other clouds may be differed for the conditions in stratus and other clouds may be differed for the stratus and other clouds may be differed for the stratus and other clouds may be differed for the stratus and other clouds may be differed for the stratus and other clouds may be differed for the stratus and other clouds as the stratus and other clouds and the stratus and other clouds and the stratus and other clouds and the stratus and other clouds are the stratus and other clouds as the stratus and other clouds are the stratus and the clouds are the stratus and the stratus are the stratus and the

During this visit to the Rigit there were a number of opportunities of investigating the water particles in clouds. The apparatus used was the small instrument described to the Society in May last. With this instrument the warmer for the state of the society of the state of the

few seconds the rate was much quicker. Though the quuck falls seldom lasted long, yet 30 drosp per sq mm per mutte were frequently observed for a considerable time. The maximum rate of 60 per sq mm per half minute gree 12,000 drops per square centimetre per families gree 12,000 drops per square centimetre per This does seem to be an enormoun number of drops to fall on so small an area in the time. These drops, however, are so extremely small they rapidly exaporate, more than two or three being seddom visible at the same me on one square of the micromiter. The denser the cloud the quicker was the rate of fall, and as the cloud duminished in size at the same time.

It was frequently observed when the mountain-top was in clouds, particularly if they were not very dense over-head, that the surfaces of all exposed objects were quite dry, not only the stones on the ground, which might have received heat from the earth, but also wooden seats, posts, &c, were all perfectly dry, and if wetted they soon dried. While everything was dry, the fog-counter showed that fine rain-drops were falling in immense numbers From the fact that the air was packed full of these small drops of water, it might have been assumed that the air was saturated, and tests with properly protected wet and dry bulb thermometers showed that it was saturated A few observations were therefore made to explain this apparent contradiction of surfaces remaining dry while exposed to a continued shower of fine rain and surrounded by saturated air The explanation was found to be, simply, radiant lieat Though the cloud may be so dense, it is impossible to see the sun or even a preponderance of light in one direction to indicate its position, yet, as a good deal of light penetrates under these conditions, it therefore seemed possible some heat might do so also A thermometer with black bulb in value showed that a considerable amount of heat penetrated the clouds under the conditions, as it rose 40° to 50° above the temperature of the air while the observatoons were being made. This radiant heat is absorbed by all exposed surfaces and heats them, while they in turn heat the air in contact with them, and the fine drops of water are either evaporated in this hot layer of air or after they come in contact with the heated surfaces Other observations made on Pilatus pointed to the same conclusion All large objects, such as seats, posts, &c., were quite dry in cloud when there was any radiation, while small objects, such as pins, fine threads, &c, were covered with beads of water. The large surfaces being more heated by radiation than small ones, when surrounded by air, these surfaces evaporate the drops falling on them, while the small ones, being kept cool by the passing air, are unable to keep themselves dry

The observations made with the fog-counter point to the conclusion that the density or thickness of a cloud depends more on the number of water particles in an othe number of dust particles in it is cloud system of the dust particles in the cloud's varied too much and too quickly to enable any conclusion to be drawn from observations made in clouds themselves. However, on comparing the thickness of a cloud on the Rigi and a fog at low level, when the number of waterdrops was about the same, it is found that the fog, though thicker, was not greatly so, although there were only a found that the housand dust-particles per cc. in the cloud, while there

were about 50,000 in the fog.

The observations with the fog-counter show that, whenever a cloud is formed, it at once begins to rain, and the small drops fall into the direr air underneath, where they are evaporated, the distance to which they will fall depending on their size and the dryness of the air. It is thought that much of the dissolving of clouds is brought about in this way.

NO. 1134, VOL. 44]

Abstract of Paper read before the Royal Society, Edinburgh, on July 6, by John Auken, F.R.S. Communicated by permission of the Council of the Soc etv.

OLD STANDARDS.

BY a curious accident it has just been discovered that the standard yard and certain other measures and weights which were supposed to have been lost when the Houses of Parliament were destroyed by fire in 1834 are still in existence The following account of the matter is condensed from a statement in the Times A reference to the contemporary records shows that after the fire the standard bars of 1758 and 1760 were both found among the runs, "but they were too much injured to indicate the measure of a yard which had been marked upon the measure of a yard which had been marked upon them." The principal injury to both of the standards was the loss of the left-hand gold stud, but whether this was caused by the action of the flames or otherwise is not known When the Palace of Westminster was rebuilt he two bars were deposited in the Journal Office, and from that time, until the other day, they seem to have been wholly lost sight of About a fortinght ago it happened to be stated in the lobby that one of the duties of the Speaker was to inspect once of the Lower Waiting Hall, Inquiries at the Standards Department of the Board of Trade elicited the fact that, so far from any statutory requirement being imposed upon the Speaker in the direction indicated, Section 35 of the Weights and Measures Act, 1878, which provides for the care and restoration of the Parliamentary copies of the Imperial standards, specially exempts the walledup copy from periodical inspection and comparison. It was found, however, that in 1871 Speaker Denison took cognizance of the standards, and this fact was brought to the Speaker's notice While inquiries were being made as to Speaker Denison's inspection, an official in the Journal Office mentioned that when the contents of that office were recently being transferred to the new wing he had observed among the lumber some old weights and measures. These proved to be the missing standards On Tuesday last they were examined by Mr Chaney, the Superintendent of Weights and Measures, and on Wednesday the Speaker was to visit the Journal Office for the purpose of inspecting them

The most important of the standards thus rescued

The imost important of the standards thus rescued from oblivion are the yard measures constructed by Bird in 1758 and 1760. The former was copied from a bar in the possession of the Royal Society, which was itself a copy of a standard preserved in the was itself a copy of a standard preserved in the district of the committee of the House of Commons from the 1758 standard. "Each of these two standard yards consisted of a solid brass bar 105 in square in section and 3973 in long. Near each end of the upper surface gold pins or studs of 101 in diameter were inserted, and points or dots were marked upon the gold to determine the length of the yard." The other standards in the custody of the Journal Office are two brass roads answering the description of the old Exchequer yard, and answering the description of the old Exchequer yard, and model, patterns, and multiples," ordered by the House on May 21, 1762, "to be locked up by the clerk and kept by him". The most important weight—the standard trop opinid—is not almost those now brought to light.

NOTES.

AT some little distance to the north and north east of Cardiff lies a heastiff piece of helly country, much frequented by pedestrans, and known as the Black Mountain or Black Fower district. It has not been fourd practicable by the Local Committee to arrange, an official excursion to this district on the occasion of the vith of the Bertish Association to Cardiffy, but a propert in pow being unofficially forwarded for conducting similar parties of not exceeding as a visitor each to some of the choicest

parts of the country, at a time so arranged as not to interfere with the sittings of the various Sections. Several local gentismen, throughly familiar with the dutrict, have offered to act as guides, and with fair weather most enjoyable excursions are to be anticipated. The country being essentially one for pedestrians, the excursions would take the form of an alternoon walk of from eight to twelve mides, with a further walk on the following days of from tweaty-five to turry mides. Any member of the British Association desirous of taking part in one of these excursions are an obtain full particularly by applying to the Local Secretaires, 9 Bank Buildings, Cardiff, who will forward the applications to the monoscier.

The annual meeting of the French Association for the Advancement of the Sciences will be held at Marseilles, commencing on September 17. The special subject chosen for discussion in the Botanical Section is the best mode of arrangement and exhibition for different kinds of botanical collections, with the double purpose of the preservation of the specimens and the facilitating of study.

The Technoal and Recreative Institute established by the Goldmuths' Company at New Cross was opened by the Prince of Weles on Wedensday In addition to this Institute there are to be two Polytechnics south of the Thames, one in Battersea Park Road, the other in the Borough Road The memorial stone of the one in Battersea was laid by the Prince of Wales on Monfay.

PROF M W HARRINGTON, the founder of the American Meteorological Journal, has been appointed Chief of the United States Weather Bureau, under the Department of Agriculture in Washington. Prof. Harrington was born in Illinois in 1848. and graduated at Michigan in 1868. In 1879 he was made Professor of Astronomy and Director of the Astronomical Observatory at Ann Arbor, Michigan From a recent article by him, entitled "How could the Weather Service best promote Agriculture?" it appears likely that the energies of the new service will be devoted more to the interests of agriculture than to commerce, and that an attempt will be made to issue special weather predictions for the farmer, by means of the multiplica tion of local forecasting stations There can be little doubtseeing the large amount of funds under his control-that he will also still further advance the important work of inter national meteorology which has been so ably conducted by his predecessor.

The balfyearly general meeting of the Scottish Metcorological Society was held in Edinburgh on Wednesday. The report from the Council of the Society was presented, and papers were read on certain relations of winds, pressure, and temperature at the Ben News Observationes, by Dr Buchan, and on influenza and weather of London in 1891, by Sir Arthur Mitchell and Dr. Buchan

FROM the official record of the work done in the British Museum during 1890 it seems that there has been a serious decrease in the number of visation. Special departments, however, have been used more than ever by students, and it is satisfactory to find that the zoological and geological collections in the Natural History Museum are being more generally appreciated.

GERMAN scientific papers record the death, on June 18, of Dr. Otto Tuchler, well known as an archeologist of wide learning and sound judgment. He especially distinguished himself by his investigation of the burni-mounds of East Prussla. Dr Tuchler was forty-eight years of age.

PROF. A. Riccò, Director of the Catania Observatory, who has just returned from a visit to the volcano Stromboli, sends us the following notice of a recent eruption .-- "On June 24, 45

minutes after noon (Rome mean time), the inhabitants of the Edolan Isles were shrared by two strong shocks of earthquake, followed by two tremendous explo sons of the volenno, which seat forth from four months a great quantity of made, cinders, incandecent blocks, and currents of lavs that descended the mountain slopes to the sea. The sea, at the points where the lave entered it, steamed up, producing great noisy masses of more returned to the sea. The office of the control of the season of the season

THE annual meeting of the Society for the Preservation of the Monuments of Ancient Egypt was held last week in the 100ms of the Society of Antiquaries at Burlington House. Lord Wharncilffe, President, occupied the chair The report stated that there was little to report of success attending the proceedings of the Society for the past year Its energies had been directed principally to two points-the necessity for an official inspector or superintendent in Egypt, whose duty should be the care of the ancient monuments, and an endeavour to do something towards arresting the gradual destruction of the Great Temple at Karnak Reports concerning a proposed scheme for barring the Nile below Phile, to make a vast reservoir for purposes of irrigation, had appeared in the public papers from time to time, and recently various more definite communications had been received by the committee on the same subject. The result would be, it was acknowledged, to completely cover this beautiful island and temple with water. There had been some correspondence on this subject with the authorities in Egypt; but as nothing had as yet been decided as to any scheme of irrigation, and as a committee would be appointed to consider the whole question. it might be considered as suspended for the present, and the committee had thought it hest to wait before taking any further action; but they would not lose sight of this important matter, and would oppose to the utmost of their power any engineering scheme which would involve injury or destruction to this worldrenowned spot. General Donnelly moved the adoption of the report; and the motion was seconded by Sir Edmund Henderson, and agreed to. The committee for the coming year was then elected, and a discussion subscouently took place as to the proposed scheme for barring the Nile below Phile, the opinion of the meeting being evidently strongly opposed to the adoution of any system of irrigation which should involve damage to the temple Mr J Bryce, M P , spoke of the wanton injury which was often inflicted on monuments in Egypt, and said that he thought it would be necessary, in dealing with that matter, to bring the question of jurisdiction to the attention of those from whom any system of inspection or care was to emanate. We may note that in answer to a question put by Mr. Bryce in the House of Commons on July 15, Sir J. Fergusson said that nothing definite had been settled as to the preservation of accient monuments in Egypt , £210,000 had been allotted in the Budget for the current year.

THE Pilot Chart of the North Atlantic Ocean for July contains a special account of a humanizan that moved along a track almost due north, about 500 miles cast of Newfoundland on June 9 and 10, together with a chart of the condition of barometer and wind between Newfoundland and Ireland, showing that the abnormal lanck was due to the approach of an anticyclone wert of the British Isles. A supplement sused with the Pilot Chart illustrates the drift of every bottle paper returned to the United States Hydrographic Office mose April 1869. There are 13 papers that contain the date makes April 1869. There are 13 papers that contain the date milles that each bottle drifted is 869, and the swenge daily drift is \$ 8 miller. This figure is rather below the true swenger size par day, as any time the bottle lay upon the shores before discovery added to its time of drift.

NO. 1134, VOL. 44]

M PATOUILLARD has just returned from a scientific mission with which he was intrusted by the Minister of Public Instruction in France, an investigation of the mycological flora of Tunis, Carthage, and the adjacent regions.

In one of the principal atticles of the Atterophysicale Zeitskry for May, Herr R Bornstein discusses the question of a connection-between air pressure and the hour angle of the moon, using as a hasty the hourly observations of four Gemma and Austran astations. This investigation differs from the usual mode of tectaments, as it takes no account of the moon's phase, or of its declination or distance from the earth, but only of the lunar day, and deals solely with aumospheric pressure. The results arrived at air. (1) that the easience of atmospheric tides is not planly recognished in the range of pressure, (2) at three of the planly recognished in the range of pressure, and three of the day. The maximum occurs at Hamburg and Breits shootly before the setting of the moon, and at Vienna about the time of the lower culmination, while the minimum occurs at all stations near the time of the moon soft range.

We have received vol. vii., of the Anales de la Operan Mateorologica Argentina I continus a summation of the records obtained at five different stations in the Republic during the years 1877-89 The organization of the Department appears to be now very complete, there being no less than twenty eight stations fully equipped with ordinary and selfregulering instruments

REFERRING to a statement which has been publicly made. that the adoption of electric lighting in place of gas at the office of the Savings Bank Department of the General Post Office has been followed by a marked reduction in the amount of sick leave, the Lancet says it has good authority for believing that the statement in question is substantially correct. Although the time which has as yet elapsed-two years -since the introduction of the new illuminant has been insufficient for the collection of trustworthy statistics, our contemporary thinks there is every reason to believe that electric lighting will prove to be much more wholesome than ordinary gas flames An electric lamp does not compete for the oxygen of the apartment in which it is placed, and this circumstance gives it a marked advantage over any open flame. It cannot, like some forms of gas-burner, be used to promote ventilation, but in ordinary situations its harmlessness is a much more important property

MELEOROLOGICAL Observatories are generally ill adapted, by reason of dust and sonce, for observation on atmosphere electricity, and, with the view of inciting private individuals to such work, Herren Elster and Genel, of Wolfenbuttel, have such work, Herren Elster and Genel, of Wolfenbuttel, have laiely issued a brockure in which they indicate the ends to be sought and the instrumental mean. Three things demand attention: first, systematic observation and measurement of electricity in the open art at different times in the day and in the seasons, himmidity and air-temperature being determined at the same time, second, measurement of the fall of potential with a clear sky; and third, measurement of the fall of potential and its change of sign during rain, &c. The instruments and methods recommended are such as present little difficulty for private persons.

THE American National Geographic Society prints in the current number of its magazine a full and interesting account, by Israel C. Russell, of an expedition to Moant St. Elias, Alaska. The paper is illustrated by various excellent maps and disgrams.

THE Winchester College Natural History Society has just smuch, under the title of "Geological Notes" (f Wells, Winchester), a list of all the fossils as yet known from the chalk in the antickinal of Winchester. The exact localities and zones are given, and, since the names appear not only to have been

carefully determined, but to be well up to date, this very modest pamphlet will prove as useful a guide to the collector as it is valuable to the stratigraphical geologist.

MESSIA WOUNGLI, MINSHALL, AND GO, Dowestry, have sixued "A Finn of O-westry and Darting," by T. P., Diamond, Honorary Secretary of the Offa Field Club. It contains a list of plants in the negleobarrhoos of Owestry, arranged according to their natural orders; and at the end there is an index, in which obth the English and the Wesh insues of the plants are given. Mr. Diamond calls attention to the dog out of the 10th and of the Wesh index of the plants are given of the state of the plants of the United Kingdom."

The United States Department of Agressiture is printing—in the series studied "Contributions from the United States National Herbarum"—what promises to be a valiable manual of the plants of the plants of Western Feas, by John M. Coulter. This district is described as "one of the richest regions in plant district, and for particularly interesting on account of the intermingling of Meascan species." The manual is being published in parts because the author's hopes this their wiscessive appearance may call forth additional information that may be embodied in a final turniformat.

A SHEAT dealing with the potato disease will shortly be issued by the Royal Agracultural Society of England. It was originally published by the Irish-Land Commission, by whose permission it is being reproduced. In the text, by Mr. William Caruthers, F.R.S., all necessity information it gives, and this is accompanned by coloured drawings illustrating various phases of the potato disease.

In the July number of the London and Maldites, Note-Disks, Mr. G. F. Lawence says he recently obtained a drill implement of unusual form from the site of Mr. Peter Robinson's new premises in Ochrol Street. The peculiarity consists of the carnous curvature of one face of the implement compared with the flatness of the other side. He does not know of another like it, but suggests that, as sitention is called to what may be a mere variation of an ordinary type, examples may be found in other collections. This specimen is of a somewhat ochross colour, is lativous and lost is glightly abrieded or rolled, and it measures §2 inches long by 3 inches wide. The occurrence of drift-implements in Central Londons is rather unusual. Mr. Lawrence thinks, twelve would be rather over than under the number known.

In the current number of the Scientific Proceedings of the Royal Dublin Society (vol vii Part 2) Mr E W L Holt publishes a preliminary note on the fish obtained during the cruise of the s s Fingal, 1890, on the Society's survey of fishing grounds on the west coast of Ireland Amongst the shore fishes, Aphia pillucida, Nardo, and Crystallogobius missonii, Dub and Kor are for the first time recorded from Irish waters The second British specimen of Arnoglossus grohmanns, Bonap , is also recorded. From depths between 100 and 500 fathoms off Achill Head, Pomatomus telescopium, Risso, Mora mediterianea, Russo, and Manurus aqualis, Gihr, are added to the British fauna, and a description is given of a new deep sea eel, intermediate between Saurenchelys and Nettastoma, which has been named Nettophichthys retropinnatus, n. g et sp. Gadus esmarkus, Nilsson, and Macrurus rupestres, Gunner, are added to the Irish fauna from similar depths, and Argentina sphyrana, Linn., from 52 to 80 fathoms. Amongst other fish recorded from depths exceeding 100 fathoms are Chimara monstrosa, Linn , Trigla lyra, Inn , Gadus argentens, Guich., Phycis blenmoides, Brunn. Halopor therus eques, Gthr., Macrurus calorhenchus, Risso, M. lavis, Lowe, &c A young Phycis is also recorded from 26 fathoms, and mention is made of the occurrence at the

surface of a shoal of young Gadus poutassou, Risso, 34 miles from land.

HARDWESS a one of the most important properties of solid boties, yet the measurement of it has not been very astifactorily effected hitherto. Frof Auerbach, of Jena, has recently described (Réviensum fur Payars) an apparatus for the purpose, designed for transparent bodies. In it the spherical surface of a lens a present up by the bort arm of a weighted lever against a small thick plate, on which the observer looks down though a merconcepe furnished with a microniver, withdrawn the effects of increasing furniture. The properties of the the effects of increasing furniture to the subject, and test if A comparison of hardnesses with models of elasticity shows that, while the more elactic of those substances were also the harder, the hardness microxies less than the elasticity

FAON recent accounts at appears that the consumption of gas in Parin in 150 occeeded that in 180 by 36 3 per cent, while the number of consumers increased 56 Spire cent. The amount per consumer discussed 156 Spire cent. The amount per consumer discussed 150 Spire cent. from 1642 to 1322 calube metres. Electricity has evidently withdrawn many large consumers of gas. The same account states that in Ariser years the number of are and glow lamp shis increased 44 quantity of the consumption of periodium in France has moreased 47 per cent in those ten years, while that of gas, in the whole of France, has grown 62 per cent.

A statis of addition compounds of alchylics with hypophophorous such an described by M. Ville in the current number of the Annales di Chinus et de Physique. As is well known, adebythe schulit the characterium property of uniting directly with inany other substances, such as ammonia, hydrocyanic acid, and sulphies, and hydrocyanime Some time ago, it was shown by Foosek that truchloride of phosphorus was likewise capable of nuting directly with many alchelydes with production of liquid compounds decomposable by water M. Ville now show that a sunfair ternet of additive compounds are formed with hypophosphorous acid, and these compounds are of conditional control of the condition o

action of aldehydes under the influence of a slight rise of temperature, two distinct classes of new compounds are obtained. When the aldehyde and hypophosphorous acid are allowed to react in the proportion of equal molecules, compounds of the R-CLI-OH

type PO-OII are obtained, where R may represent the

are formed. The aldehydes of the aromatic series lend themselves best to the formation of these compounds, those of the fatty series exhibiting a great tendency to the production of condensation products The compound of the second type with C2H.—CII.—Oil

benzoic aldehyde, PO-OH, is obtained by digesting to-

gether for several hours upon a water-bath bennaldehyde and hypophosphorous acul man attausphere of carbon disoxde Crystals of the new compound soon commence to separate, and repully permeate the whole liquid On draining and washing, they are found to consust of colourleus radiating groups of lamelle. They are not very soluble in water, but disolvie more readily in organic solvents, best in methyl alcohol. The aspects obtains a strongly acud, deconpoung exchanates readily, and forming crystalline salls with base? Currous phosphorous control of the control

In order to obtain the acid of the first type, PO-OH,

it is bet to employ an excess of hypophosphorous and In this case, instead of cytals of the nad of the second type separating, the whole forms a homogeneous liquid which remains unpre-cipitate by water Ir contains the each of the first type, and this latter is best in later by precipitating by water in contains the each of the first type, and addition of lead scente and decompoung the salt, suppended in water, by means of sulphuretted hydrogen. On concentration of the filtered solution, a syrup is obtained which eventually yields deliquescent crystals of the pure acid. The solution plant is not the solution of the filtered solution, a syrup is obtained which eventually yields deliquescent crystals of the pure acid. The solution of this nord does not reduce copper sulphate, but readily precipiate-metallic silver from silver nature. Many similar compounds with other additionals have also been prepared, and found to present analogous properties more or less modified by the specific nature of the particular additivity deep employed.

This additions to the Loological Society's Gardeas during the past week include two Raddy-headed Genet (Bernaile ratiolatery) & form the Falkiand Islands, presented by Mr. F. L. Blauwy, C. M. Z. S., a Smooth Sincke (Cornealla Levil), British, presented by Mr. W. H. B. Pain, two great Eagle Owis (Bibbo) measures), European, depotude, as K. Syed. Lizards (Laceria cellitals), two Four-lined Snakes (Caladre yaudstineatist), a Rack-marked Sakes (Rinnerks scalars), South European, purchased, a Burshel Wild Sheep (Owis burshel d.), a Ipanese Deer (Cervan Link P), a Bennerit Wallaby (Edmadarusa tennatis V), two Night Herons (Nycticeras griseus), bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

A CAURE OF LUNAR LISBATION —A paper by Mr. S. E. Peal, "On a Powible Cause for Lunar Libration of her than an Ellipsoidal Figure, and on Lunar Snow Mountains," has recently been published by Mears Dulian and Co. It is shown that a been published by Mears Dulian and Co. It is shown that come the property of the proper

thifted about 30°, so that the touth pole occurs near Nach or Magmes, all these reregular ments form a chun of seas along the equator, which may represent the season of t

Double-even. One partitions—In Autonomiche Morischlen, No. 3047 and 30,58 Mr. S. W. Burnham gives the results of his double star observations made in 1890 with the first of the Leek Observations. The stars which measured on account of their being beyond the reach of say but the most powerful relessage. W. Burnham also notesthat has purpose has not been to find at many pairs as possible withments of the partition of the star of the star of the star contains, 70 pairs, of which 33 have distances less than 1', with an average distance of 0' 45

an average avanue of 435 are included in the list of new hunaries:—B A C 230, 48 Cepher (H), 5 Camelopa dist, 7 Herouls, Cen 199, 34 Perse, F Geunnorm, 24 Aquari, 95 Fricam, B. A C 1142, 36 Gennorum, 64 Aquari, 24 Perse, Tauri 148, 56 Gennorum, and the following parts, personally known, have been found to be more clo ely double—H 1981, 5 Qo., 2 800, 103 (app.) 77, 2476, O.2 442, 12 (app. 11)

CHESTATIONS OF AUE ZODIACAL COUNTER GIOW—As a couns of observations of the colinoid counterflow, or Gegorscients, made at Mount Hamilton from 1888 to 1891, is contributed to the Astronucial Journal, No 243, by Mr E E Barnard The changes of form previously noted have been large and rounds. It afterwards becomes elongated, and connected with the todiacal light by a narrow sodiscal band. The observations prove that the Gegenezies does not be in the ediptic, although term enaity. See The Control of the Gillowing longuiste and latticed to the phenomenon—in

$$\Theta - \lambda = 180^{\circ} 6, \beta = +1^{\circ} 3$$

THE OBSERVATORY OF VALE UNIVERSITY —The Report for the year 1890-91 of the Observatory of Yale University contains a report from Dr. Elkin, from which we make the following extracts.—

"In observational work with the helionater I have been engaged almost wholly in the communition of the series on the nearest of the series on the series of the series of

"The trangulation of the comparison stars for Victoria according to the plan drawn up by Dr Coll has been earned out by Mr F. I. Chase, who secured some 450 measures of these stars during the months of June to October 1850. Mr Chase has also reduced the observations as far as it was advivable for ut to do so here, and the results have been communicated to Dr Cill, along with the reduced results of our observations of Victoria and Sapphon 1859. Since Perfusion 1970 along with the reduced results of our observations of Victoria and Sapphon 1859. Since Perfusion 1970 along with the reduced results of our observations of Victoria Results of Victoria and Sapphon 1859. Since Perfusion 1970 along the star in Comme Results and Comme 1970 along the Perfusion 1970 and 1970 along the Perfusion 1970 and 1970 along the Perfusion 1970 along the Perfusion 1970 along the Perfusion 1970 and 1970 along the Perfusion 1970 alon

"It is proposed during the ensuing season to devote the heliometer to a series of measures on the satellites of jupiter for the determination of their orbits and the mass of the planet, comparing them sites, as has been done with such success by Hermann Struwe at Pulkova with those of Sautra."

THE RECENT EPIDEMIC OF INFLUENZA.

THE morally in London from influents shore a Stady of decline work by week, and, although the number of dealbs in still in excess of the average, there are good reasons for hoping that the epidemic will shortly desappear from our midst. The seventy of the recent viviation, as compared with that which presulted into year, in clearly shown by the are displayed slide by nice. The weekly morality from influents alone is represented by the third curve, the number of deaths

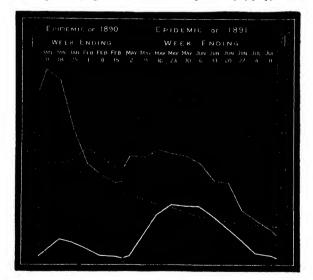
from diseases of the respiratory system by the lighter curve, and the average number of deaths from disorders of the latter class by a dotted line. The average mortality from influenta is too small to permit of any curve being drawn upon the scale shown in the diagram.

in the enagram. Taking into consideration, firstly, the mortality from influenza slone, we find that not only was the duration of last
year's pedieum far less than that of the present year, but that
the number of deaths in the earlier period was very much smaller
than in the latter. The epidemic of 1850 set in with great
severity and suddenness at the beginning of January. During
the week ending December 28, 1889, there were no deaths in

the epidemic prevailed with more or less severity, it appears that the total number of deaths in London was 442, giving an

that the total nomber or centra un Lousou was 444, grangs average of 7, per week.

The vastation of the present year may be said to have commercial at the beginning of May. During the whole of April mercial at the beginning of May. During the whole of April weeks embraced by the Reguttra-General's returns being respectively 7, 3, 9, and 10. By the week ending May 2a, however, the number had risen to 37, and from this time conward the disease continued to spread with alarming rapidity, the numbers in the three successive weeks being 148, 266, and a maximum during the week ending May 33 of 319 In the two



London from this disease, and in the following week only is to the week confing fanary 1, 1850, however, he number had risen to 57, while in the course of the ensuing seven days a metallic three transitions of 127 was reached. The mortality then declined stradily, the numbers in the four succeeding weeks being respectively, 105, 75, 58, and 30, 48 a serious spedentic the restriction may then be regarded as having spent itself, and in include any period in which the weekly number of deaths fell below 25. It may, however, be remarked that, for three week subsequent to that shown by the curve, the mortality exceeded 20, while in the four succeeding weeks it ranged between 20 and 37 Taking as v whole the period of an weeks in which

ollowing weeks the mortality spain exceeded too, after which it and ecclined steadily to ago, 183, 117, and 56, while in the hast period shown by the diagram the number had fallen to a faing the period show by the diagram the number of deaths in London Taking the period as a whole; it appears that dramp the eleven weeks exding July 11 the total number of deaths in London to the period of the control of the state of the control of the state of the control of the state of the control of the control

From an examination of the statistics given in a valuable

paper read before the Scottish Meteorological Society on March 31, 1890, by Sir Arthur Mitchell and Dr Buchan (an abstract of which appeared in NATURE, vol xl., p. 506), it is quite evident that the recent epidemic of influenza has been the most severe we have that in London since the first publication of weekly severe we have had in London since the first publication of weeking records of mortality some forly-five years ago. As the figures are of great interest, we make no apology for reproducing the brief table given in that paper, showing the number of deaths which occurred in the five principal epidemics experienced uncet the year 1847. It will be observed that the number given for last year is considerably in excess of that quoted above, the period selected by the authors of the paper comprising the whole of the three months January to March In the month last menof the three months January to March In the month last men-tioned, the epidemic was certainly not of any great severity, but as the figures do not clash in any way with the general argu-ment, I have not thought it advisable to alter the results An addition has, however, been made to the table, by including the figures of mortality reached during the epidemic of the present

December 1847 to April 1848 .	Death 163
March to May 1851 .	251
January to March 1855	130
January to March 1855 November 1857 to January 1858	12
January to March 1890 May to July 1891	54
May to July 1891	202

It will be seen from the table that the mortality recently experienced has been far greater than at any other period during the forty-five years, the nearest approach to so severe an epidemic being in 1847-48, when the deaths amounted to about 400 less Taking into consideration the fact that the population of London As years ago was very much smaller than it is now, it may at the first blush appear that, as regards severity, there was not very much to choose between the two visitations. It must not be forgotten, however, that in the earlier period the ravages of the disease extended over five months, while in the latter

they were confined to about two and a half

they were confined to about two and a hair.
A very striking feature in the disease to which the somewhat
militeding name of influenza has been given, is its peculiarly
weakening effect upon the lungs and bronchial tubes, and as the
epidemic is invariably attended by a high mortality from respira-tory diseases. I have included in the diagram a sense of curves
showing the number of deaths from these attendant disorders. showing the number of central from these attendant cuspruers. As regards the epidemic of 1890, it may at once be confessed that the curve is somewhat misleading. During the last few days of 1889 and the opening of the following year a sharp touch of anticyclonic cold was experienced over England, and in the metropolis this was accompanied, as is so commonly the case, by thick fog Under such circumstances a high mortality from respiratory diseases followed as a matter of course, so that when we examine the curve we find that, at the time when the epidemic of influenza was only just appearing, the deaths from lung dis-orders were at their maximum. After the first week in lanuary, however, the weather became unusually mild for the time of year. a long period of south-westerly winds setting in, with abnormally high temperatures. There can be little doubt, in fact, that at the nign temperatures, asser can os entre count, in act, max at me time the influenze apodemic of \$500 was raiging the effects of tem-perature and weather were so strong as 10 obliterate the influences of the mismatter disorder upon diseases of the respiratory amount be eliminated from second, methodological element may almost be eliminated from second, published old winds were second to the source of the second of very frequent in May and the early part of June, the severity of the weather was not such as to lead to any material increase of the weather was not such as or sear to any manerial increases or individually from the class of diseases in question. The spread of influenza was, however, soon followed by a serious rise in the death-rate, and in the course of the fortnight ending June 6 the

destinate, and in the course of the featingle ending. June 6 the mortality from respiratory compliants amounted for more than twice the average, the large excess bring due chiefly to death from pneumona and bronchils. The subsequent decline of in-flering a was accompanied, as will be seen from the curve, by a stream of the second of the contract of the course, but a twan not until the last week of the period fast produces, but short of the average. Taking the eleven weeks as a whole, it appears that the total mortality from respiratory disorders amounted to 5136, or about 75 per cent. more than the average During the epicienic of 1000 the acount number was far larger, and as a matter of fact the excess above the normal onlymmounted last week to 26 per cent. The Report of the Committee appointed to consider the aestion of securing the aid of specialists. The meeting was eminently pleasant and successful, thanks to the untiring energy and evertions of the President and of Mr. S. F Harmer (Fellow of King's College), the Local Secretary and r riarmer (reilow of King's College), the Local Secretary and Treasurer. Under their guidance several colleges, thoranes, and laboratories were visited Prof Middleton conducted a party over the Fitzwilliam Museum, and, through the kindness of Prof. Newton, a few of the members visited the Pepsian

The influence of the weather upon the two enidemics seems to I he immence of the weather upon the two epidemics seems to have been exerted in entirely opposite directions. During the epidemic of 1850 temperature was, as we have already seen, for the most part very high for the time of year, and the pre-valence of a strong current of south westerly winds in January doubtless added in the dispersal of the measmantic germa. The weather was, in fact, as favourable as could have been desired, and weather was, in fact, as involved as could nave need cearriest, and the ravages of the epidemic, severe though they were, were doubtless much milder than they would have been had the winter heen cold and foggy. The recent epidemic has not had so many foes to contend with, for in the carrier stages of its career the weather was not only cold for the time of year but also calm and quict. The germ was therefore able to settle in our midst without serious opposition, and the ungenial nature of the atmosphere has doubtless been responsible for much of the lung and bronchial disease which has followed in its train Deluded by the knowledge that the spring season was upon us, and forgetful of the fact that it had come in an unkindly guise, many a weakly convalescent has been emboldened to venture out into the chilly air. and has contracted a serious cold, from which in too many cases he has been unable to recover. FREDE L. BRODIE.

THE MUSEUMS ASSOCIATION

THE Museums Association held its second annual meeting in Cambridge on July 7, 8, and 9, under the presidency of Mr John Willis Clark, Superintendent of the Museum of Zoology and Comparative Anatomy, Cambridge, and Registrary of the University.

The following representative of Mixeums (outside Cambridge) and associates were present —The Rev H. H. Higgins, Mr. R. Paden (Liverpool), Mr. R. Cameron, Mr. I. M. E. Bowley, Standerland), Mr. G. R. Bothers, Mr. J. W. Cerr (Notting-ham), Mr. Councillor I. Burt, Mr. J. Pacon (Giasgow), Nr. Stockport), Adderman W. H. Brittian, Mr. F. Howarth (Sheffield), Mr. Joseph Clarke, Mr. G. N. Maynard (Saffrod Mysiken), Mr. S. Washerman, W. H. Brittian, Mr. F. Howarth (Soffield), Mr. C. Madeley (Warrington), Mr. I. Lyon, Mr. J. J. Del (Bodtel), Mr. W. E. Holye (Deven College, Manchester), Mr. H. M. Patanseer (York), Mr. F. W. Radder, Mr. F. A. The proceedings were opened by the Rev. H. H. Hierons. The following representatives of Museums (outside Cambrid

Bather, Mr. A. Smith Woodward
The proceedings were opened by the Rev. II. H. Higgins
[Past-Fre-ident), who introduced the Fresident, Mr. J. Willis
Clark. The Fresident then read his address, and gave a short
and very interesting account of the early history of Cambridge
and of the foundation of a few of the older Colleges. On the 8th and 9th the following papers and reports were read and ducussed

- "On some old Museums," hy Prof A Newton, F.R S,
 "On the desirability of exhibiting, in Museums, unmounted
 skins of birds," by the Rev II II Higgins "On difficulties incidental to Museum demonstrations," by
- F. W. Rudler. "On the Dresden Museum cases," by Dr. A. B. Meyer,
- "On the registration and cataloguing of Specimens." by W E. Hoyle
- "Some recent Museum legislation," by E Howarth
 "On the arrangement of Rock Collections," by I
- Platnauer "Fossil Crinoidea in the British Museum" (an attempt to out into practice modern ideas of Museum arrangement), by F.
- Bather.
 "On Tables and Chairs," by F A Bather.
- The Report of the Committee appointed to consider the question of labelling in Museums

TECHNICAL EDUCATION IN INDIA.

CIR AUCKLAND COLVIN, the Governor of the North-Western Provinces of India, has issued an exhaustive minute on technical education in that country, in which the various steps towards the introduction of this system of instruc tion are summarized. The minute naturally refers chiefly to the North-Western Provinces, but is in fact a summary of what has been done elsewhere. It seems that the idea of introducing technical education in the North-West Provinces, where their has hitherto always been a steadily increasing demand for University education, was first mooted in September 1885, when the attention of the local Government was called to the Madrae the attention of the locks coveriment was saired to the examination, scheme, which aimed at promoting instruction in industrial arts and manufactures by offering grants in-aid to encourage the teaching, in schools so aided, of technical science, arts, and handicrafts, and by testing that teaching by a system of public examinations. Nentry a year later the Home Secretary to the Government of India drew up a note on the subject generally, pointing out that there was room for improvement in this branch of education in the great north-west, and inquiring what was being done. The Director of Public Instruction replied that the question of establishing Faculties of Medicine and Engineering was under consideration in the Allahabad University, and ing was under consideration in the Aliahabad University, and also certain perparatory courses of study, while it was proposed about certain perparatory courses of study, while it was proposed Local Records Department. In January 1888, Colonel Forbes, replying to questions addressed to him regarding instruction in engineering, said he considered that the practical instruction gained by nature in the large railway workshops at Allahabad, Lucknow, and Labore, and at the Government workshops at Euckniow, and Layore, and at the trovernment workshops at Roorkee, was decidedly bearing fruit in the direction of enabling natives to take intelligent and independent control in these branches of technical industry. The railway and Government workshops he considered were the real technical schools so far as workshops he considered were the real technical schools so far as that branch of instruction was concerned, and there was no need, therefore, for the Government to establish itschined and the state of though such opportunities need only be limited in number. "For the higher grades of engineering. I thank the ordinary liberal education with a scientific knowledge is most suited, until a man is of an age to know his mind, and elect for the profession, when there should be a strictly technical education for a limited time, two or three years, followed by a careful apprenticeship on works." The late Colonol Ward contended apprenticeship on works." The late Coionci ward contended that facilities should be given at the Roorkee College for practical instruction, in addition to the present theoretical course "If such a technical practical class were formed at Roorkee, students from the schools might be allowed to attend it without going through the College theoretical course." on, the Director of I and Records and Agriculture sent in an opinion on the subjects immediately referred to him, and advocated nothing more than the creation of a normal school for survey only, at Cawnpore or Lucknow, suggesting also the establishment of small scholarships for the maintenance of boys in training at the various workshops in the provinces; of an art school at Lucknow, and of agricultural and veterinary schools or classes in high schools, and he proposed that drawing should be made compulsory, competency to teach drawing being pre scribed as an essential qualification in all teachers in middle and high class schools. And finally, the Inspector-General of Civil high class schools. And many, the inspector-teneral or civil Hospitals reported against the proposal to teach up to a higher standard than that of the hospital assistant class. Then, in March 1888, the Director of Public Instruction forwarded a second report adverse to the establishment of a school of art at Lucknow, and pointing out further that, however desirable was the proposal to introduce drawing into public schools, there were no funds available for the purpose. At the close of the year the prector forwarded a resolution, on the part of the Senate of its Allahabad University, to the effect that any steps to establish a College for training medical practitioners would at precent be premature. At this point, says the Times of India, in discussing Sir Auckland Colvin's minute, the cold water current ceased. In the February of last year the Director of Public Instruction

forwarded a mutute by the Allahabias I censte, it which it was decirated to establish a Faculty of Engmenting, degrees burge conferred on men who had passed at least a three years theoretical connex at a properly constituted. Engmenting College or school. The property of the stable to grapher, the only place at which engineering can be tautied in the North-West Provinces in Roorkee. The Public Works Department, he adds, so of opinion that if degrees are to be conferred by the Allahabad Unremy the Konkee certificate be conferred by the Allahabad Unremy the Konkee certificate benefits of the property of the property of the property of the Control of the Comment. Then the establishment by the University of a special examination of "a connecreal and training class for technical electation, still remain under consideration. The general conclusion, Str. A. Colvin thinks, as the, on the whole, opinion points to onlying more suggest or obtaining instruction in the salicoritistic grades of practical engineering, and in the handsterf of the artists. Str. Auckland Colvin then sums up the subsequent papers on the subsect, relating to the offer of the British Indian Association in 1978, a 500 per month, a school of industry in one of the Wingfield Manali subsequencing, reaching & 17,440 per anisom, to the offer of the British Indian Association in definition individual subsequency, reaching & 17,440 per anisom, to the drivated by the British Indian Association in definition of the warded by the British Indian Association in definition of the warded by the British Indian Association in definition of the warded by the British Indian Association in the dark and forwarded by the British Indian Association in the dark and the contraction of the British Indian Association in the dark and the contraction of the British Indian Association in the dark and the contraction of the British Indian Association in the dark and the second of the second of the second of the seco

Sir Auckland next devotes himself to a consideration of the systems of technical instruction at work in Bombay and Bengal. systems of technical instruction at work in Bomony and Bengai. From a careful study of the facts and the more or less volumin us papers in which they were originally enshrined, he proceeds to define what is meant by technical education so far as at is applicable to the North-West Provinces. Technical education in Europe he illustrates by Mr Scott Russell's words . "It is necessary that each individual shall, in his own special profession, trade, or calling, know more thoroughly its fundamental principles. wield more adroitly its special weapons, he able to apply more skilfully its refined artifices, and to achieve more quickly and economically the aim of his life, whether it be commerce, manufactures, public works, agriculture, navigation, or architecture;" and by an extract from Mr. Kirkham's report, in February 1889, to the Bombay Government "The general principles that the shops are only called into existence by capital operating in ac-cordance with its own law—that this training, so far as it can be cordance with its own law—that this training, so far as it can be given in schools or colleges, must be, in the main, preparatory and disciplinary, and that is improvement of science teaching are the indepensable perluminates of any form of practical training. It is those to the indepensable perluminates of any form of practical training. It is those to the main the indepensable of the matter is concerned, directly they come to the practical details there is, as Mr Kirisham admits, every to the practical details there is, as Mr Kirisham admits, every the control of come bound designed to the present of the property sizes in 10 come bound of the control of the present of th in a way to differ from every other system, just as the leading industries of different districts differ Apart from this, however, industries of different districts differ Apart from this, however, the Bombay ystem was found to be far too elalorate for the North-West Provinces From Bengal Sir Alfred Croft wrote a very practical and sensible letter, condemning the abolition of the Seebpore workshops, and urging that the primary point, so far as engineer students were concerned, was to learn how to use their hands He also quoted Mr Spring, who says there can be no question as to their superiority for public works employment if the men have gone through the course of manual training.
"An engineer who has learned to use his hands is, other things being equal, an all round better and more useful man than one who has not "Sir A Croft goes on to further condemn the neing equal, an air round better and more useful must train one who has not: Sir A Corf goes on to further condemn the removal of the Scebpore shops from the point of view of the need of the mechanic class. "It may be freely admitted and taken as proved that the maintenance of the shops is undestrable from the point of view of the Public Works Department. But it is no less clear to me that the interests of that Depart-But it is no less clear to me that the interests of that Depart-ment are in this matter antagonist to those of technical educa-tion; and that the deliberations of the Committee large been chefly governed by regard to the former. The Gorgianems, however, remained in principle annoved; but happily in practice they agreed with the Director of Public Instruction, and the Government of India followed suit; thus establishing a very important principle in regard to technical education. Armed with all this experience, and conceding for the moment the

existence of a demand for men competent to deal with machinery and familiar with all the lower forms of engineering, Sir A. Colvin proceeds to discuss what course the training should take, how best to secure it, and the sources from which the necessary funds could be obtained. With regard to the first point, he thinks that what would mostly he required are facilities for gaintnins mat what would make a protectal knowledge of the more and a protectal knowledge of the more sary to a foreman mechanic, more especially in connection with the steam-engine, the railway workshops, and the ron foundry, and also of the processes of cotton-spinning as employed in the mille established in the North West Provinces. "These are the two great branches of industry which in Bombay have been recognized as fields for native labour which, though in a lesser degree, exist here (in the North-West Provinces), and in regard to which, at present, specialized means of instruction are unquestionably, in these provinces, wanting "With regard to the second point, there exists at Roorkee a Government Engineering College and Government workshops, and it seems probable that these will form the nucleus of the instruction necessary As to the third point, Sir Auckland Colvin thinks it would be premature to enter into the question of funds until the dimensions of the scheme are definitely decided upon—Finally, to see how far all these views meet the industrial needs of the province. Sir Auckland has decided to seek the aid of a strong Committee, which will obtain from all available quarters information on the points indicated in the minute, deputing members to Calculta, Bombay, and Madras, and subsequently reporting to Covernment the result of its inquiries, with its own recommendations, and with full details of any scheme which it may desire to see carried into effect

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

Oxford —The judges for the folium of Memoral Prize, 1891, have swarded the prize to Mr. M. S. Pemberg, B. A., Christ have swarded the prize to Mr. M. S. Pemberg, B. A., Christ Worth of Mr. F. P. Howard, B. A., Ballot Lollege Balmon Prize consist of a gold medial of the value of ten planno Prize consist of a gold medial of the value of ten planno Prize consist of a gold medial of the value of ten when the prize is awarded every fourth year to the randitude who produces the best easy as some subject connected with astronomy or meteorology. The selection of a subject standards—transport where we were supported to the candidates. This year three were star condidates are three were ast condidates. six candidates.

Mr. Pembrey was a Fell Exhibitioner of Christ Church. gained a first class in the final honour school of natural science in 1889 (physiology), and obtained the Radcliffe Travelling Fellowship in 1890 Mr. Pocock was placed in the first class of mathematical moderations and also in the final mathematical schools, Trinity term 1891 Mr Howard was placed in the second class of the final honour school in natural science (geology), and olusined the Burdett Coutts Scholarship in 1800.

SOCIETIES AND ACADEMIES LONDON.

Chemical Society, June 18-Prof A Crum Brown, F.R.S., President, in the chair - The following papers were read -A note on some new reactions of dehydracetic acid, by read —A note on some new reactions of dehydracetic acid, by pass ing chyl aceto acetate brough a red hot tube, it is stated that alcohol is formed, the author finds that large quantities of ethylene gas and acetone are also produced. Dehydracetic acid, had so volatite to a considerable extent with steam, and is decomined. posed by boiling with water to a small extent into cerbon goed by Johnig with water to a binal extent into carbon dioxide and dimethylpyrone This latter decomposition is more readily effected by boiling the acid with strong hydro-chloric acid. If 50 grams are boiled with ordinary funning hydrochloric acid, the whole is converted into carbon dioxide and a soluble compound of dimethylpyrone with hyllrochloric acid. and a soluble compound of dehydractic acid, $(C_1H_0Q_1)B_1$, seems to be not a sair of the compound $C_2H_2Q_2$, but of the true tetracetic acid, $(C_1H_2Q_2)B_1$, as seems to be not a sair of the compound $C_2H_2Q_2$, but of the true tetracetic acid, $C_1H_2Q_2$. A very stable copper sait of the formula $C_2H_2Q_3$, D_1Q_2 is obtained if dehydracetic acid be added to a solution of copper acctate in a large excess of

nonts -The lactone of triacetic acid, by Dr J Norman In a former paper on the constitution of dehydracetic acid (Trans Chem Soc, 1890, 189) the author pointed out that if the formula which he proposed for dehydracetic acid was correct it would be the 8 lactone of tetracetic acid. And the correct, it would be the 8 lactone of terracetic acid. And the following list was given showing the connection between the condensed acids formed from acetic acid. CH₂CO (CH₂CO), CH₂CO (H₂CO), tetracetic acid. CH₂CO (CH₂CO), triaccite acid. CH₂CO (H₂CO), triaccite acid. CH₂CO (H₂CO), triaccite acid. CH₂CO (H₂CO) acetic acid. At that time no acid corresponding to the triacetic lactone of this acid by the action of 90 per cent sulphuric acid on dehydracetic acid at a temperature of 130°-135" on dehydracetic acid at a temperature of 130°-135°. The proporties and reactions of the new compound are described—
The refractive power of certain organic compounds at different temperatures, by Dr. W. H. Perkin, F.R.S. The magnetic relations of sulisiances when examined at temperatures wide relations of substances when examined at temperatures swite aparts show that certain wratteness take place after allowing for any analysis of the refractive power of liquids under similar circulamstances. The results show that the specific refractive power is not contact for all temperatures. By comparing the lines A and F. it was found. that the dispersion was slightly diminished by rise of tempera-

ture The results were calculated by the formula $\frac{\mu-1}{d}$ When calculated by Lorentz's formula: the numbers gave higher results for high temperatures than for lower ones. Sive on a value for high temperatures than for lower ones. Sive one as value for high temperatures that the same properties of the same properties of the same properties. The formation of salls, a contribution to the theory of electrops and of the nature of chemical change in the case of non-electroptes, by 11 b Armstrong. The author draws attention to the recreat researches of Glassen, W. Wallectras, and others, which clearly show that ethereal salts form compounds with sodium ethylate, and to the bearing which these results have on some envisace, and to the bearing which there essents have on the theory of the formation of salts generally. It may be sup-posed that the ackl and the "base" in the first instance com-line, and that the salt is formed by subsequent interactions within the molecule. In like manner, acids form dissociable compounds with water, and by the occurrence of change within compounds with water, and by the occurrence of change within such systems, under the influence of electromotive force, electro-lysis is effected. When the compound is highly unstable, the opportunity for change within its system is alight, the acid is a week one, and its solution of relatively low conducting power. In the case of non-electrolytes, the occurrence of change may be In the case of non-electrojytes, (no occurrence or change may one supposed to occur within complex systems formed by the union of the interacting substances—Dibensyl ketone, by Dr. S. Vonng. The author finds that, in preparing the ketone by heating calcium phenyl acetate in a combination furnace, only 27 per ceni of the theoretical yield in obtained. However, if 27 per cent of the incording yield is obtained. However, if the calcium sail be heated by means of the vapour of boiling sulphur, the yield of pure ketone amounts to 76 6 per cent.—

The vapour pressures of dibenryl ketone, by Dr. S. Young —

The vapour-pressures of mercury, by Dr. S. Young I wo additional observations of the vapour pressures of mercury at 183° 75 and 236° 9 have been made, and, from the previous results of Ramsay and Young, the boiling point and the vapourpressures of mercury have been recalculated

prevares of mercury have been recalculated June 25.—Extraordinary General Meeting —At the request of cerian Fellow, to the President, an extraordinary general meeting was summoned to consider a proposal for amending and altering the by-law. The proposal was moved by Mr. James Wilson and seconded by Dr. Teed Mr. Castriphe moved the following amendment. "That this meeting declines to pledge itself to any amendment or modification of the by-laws which used to approximate the constitution of the by-laws which the present the constitution of the present constitution of the by-laws which the present the constitution of the present constitution of the present the present the constitution of the constitution of the present the present the constitution of the constitution of the present the present the constitution of the constitution of the transfer of the constitution of the constitution of the transfer of the constitution of the constitution of the transfer of the constitution of the constitution of the transfer of the constitution of the constitution of the transfer of the constitution of the transfer of the transfer of the constitution of the transfer of the constitution of the transfer of the constitution of the constitution of the transfer of the constitution itself to any amendment or modification of the by-laws which his not been approved and recommended to the Fellows for adoption by the Council." Sir F. A. Abel seconded the amendment Mr. Cassell, Mr. Lloyd, and Dr. Newton spake in favour of the original motion. Prof. Tilden, Mr. Warington, Mr. Page, Dr. Odhing, and Mr. Friswell spoke in favour of the amendment was carried by 137 votes to 47.

Academy of Sciences, July 13 -M Duchartre in the chair.

-Calculation of the mean length that a circular tube widened at —Calculation of the mean rengen time a circular wave memorar as one end should have in order that a sensibly uniform reference might be establishment of this reference, by M. Boussineaq — Contribution to the study of what are called natural prairies, by M.

A Chatin —On alkyl cyanides, cyanobenzene, and orthocyano toluene, by M A Haller.—Experimental acrodynamic researches and experimental data, by Prof. S. P. Langley (see p. 277).—Observations of solar spots and faculæ, made with the Brunner Observations of solar spirst and facular, made with the Brutaner capatorial of Lymos Observatory, during the first set moghts of this year, by M Em. Marchand—On a modification of the method of supporting railway and framway whethes, by M Feraud—On the measurement of capacity, self-induction, and mutual induction by experiments on aerial wires, by M Massin.—On a new copper hydride and the preparation of pure nitrogen, by M A Lelia. The new body was discovered in the course. by M. A. Leduc. The new body was discovered in the course of some experiments on the preparation of pure nitrogen by passing undried air deprived of CO₂ over copper turnings in a glass tube heated to reduces and then reducing the resulting oxide by hydrogen. The composition and properties of this hydride have not yet been studied, but from the fact that it is formed at red heat it appears to differ from the body discovered by Wurtz, which is broken up at about 60° C.—Action of light on silver chloride, by M. Guntz. The experiments indicate that when a layer of silver chloride is exposed to light it becomes divided into three superficial layers, the first of which is metallic silver, the second silver subchloride, and the third unaltered silver These three layers have a thickness which is a function of the duration of exposure, and of the primitive thickness of the of the duration of exposure, and of the primitive thickness of the layer of vilver chlorde experimented upon.—On a new gaseous compound, phosphorus pentafluochloride, by M. C. Foulene. The formation of this compound is expressed by the formula $PF_+ + Cl_p = PF_+ Cl_p$, which also indicates that a contraction of volume occurs. Thu has been proved experimentally. The gas is colourless, and have an irritating odour. It is density is 3 on. is colouries, and has an arrieting colour. In density is 5 go. and it may be liquefied at ordinary pressures by reduction to a temperature of -8°. Reactions with sulphur, phosphorus, colonium, magnesum, mercury, and various other substances, than Frof Thorpe's phosphorus pentaluoride.—Compound horon bromde with phosphoreties hydrogen; phosphide of boron, by M. A. Beson. Bromde of boron absorb-propheretic hydrogen; and other phosphide of boron, by M. A. Beson. Bromde of boron absorb-propheretic hydrogen; and the phosphoretic hydrogen; and the light solid. The composition of this product appears to be represented by the formals BRP, EH, At about 300° is changes colour, and hydrodromic social schenged. The dark DOWN DOMY that remains is found to contain only phosphorus and boron, the action that takes place being expressed thus—BBrs PH = PB + 3HBr Boron phosphide has a density about the same as water, in which it is insoluble Reactions with various substances have been investigated.—Researches on the succession of the substance have been investigated.—Researches on the succession of the substance have been investigated.—Researches on the succession of the substance has been substantially also been substantially as the substantial properties. ing point brought out by the experiments is that an analogy exists ing point brought out by the experiments is that an analogy exists between arronium, tin, and intanum—Artificial production of datolite, by M. A. de Gramont. By the action of a solution of borate of socilum on silicate of calcium (formed by the precipitation of calcium action of borate of socilum of solution of calcium the action of calcium than another of calcium than a total under pressure, a hydrated silico-borate of calcium has been and under pressure, a hydrated silico-borate of calcium has been and under pressure, a nydrated since-horate of calcium has been obtained, which in composition and physical properties appears to be identical with datolite. This is the first alice borate of definite composition, and corresponding to a natural product, which has yet been obtained.—Action of boron fluoride on nitriles, by M. G. Patein.—On the acid sulphate waters containing from and aluminium of the environs of Rennes-les-Bains (Aude), by and alumanum of the environs of Kennes-le-Bans (Audel), by M. Ed. Willin, —On the formation and outdation of nutrite during nitrification, by M. S. Winogradski —On the larva form of Parmophori, by M. Louis Botalan.—On the caredalony and Parmophori, by M. Louis Botalan.—On the caredalony and on the genus Zuclea (Ebenaceut, by M. Paul Parmonter.—On the genus Zuclea (Ebenaceut, by M. Paul Parmonter.—On the structure of the primary biser-ligneous system, and on the disposition of foliary traces in the branches of Lepidocheutron singanousle, by M. Maurice Horseleque,—On a fall of small cultureous stones which recently occurred in the Department of the Aude, by M. Stannish Menure.

AMSTERDAM

Royal Academy of Sciences, June 27—Prof van de Sande Bakhuyen in the chur.—Mr. Pekelharing communicated that mag fission authorite platma or kalium-oxiake-plasma contains a affixiance which has no active power on pure fibrinogen, and the contraint of the contra of fibrin terment prepared from washed blood-clot This sub-stance is precipitated incompletely by dialysis, and completely by acturation with magnesium-sulphate. Its combination with

lime is active also in the presence of ammonium-oxalate. In the formation of fibrin, lime is transferred from the ferment to the formation of fibrin, line is transferred from the ferment to the fibrinogen. Peption prepared by neutralizing the hydro-chloric ack of the digesting fluid with ackloric arbonats, clotting of the blood. Wooldridge's "tissue-fibrinogen," pre-pared from the thymns of his call, causes coagulation of a pure solution of Linamarster's fibrinogen when line-salts are present. -Mr van Bemmelen communicated a research of Mr. Schreine-—Mr van Bemmeien communicated a restaten au art, sourreute-maker's on the equilibriums which are possible between the double sail Pb[a2Kl and water, in the pre-sence or the absence of an excess of one of the components, or of the double-sail itself, or of both. The results are in accordance with the in-vestigations of Dr. Bakhuis Rossehoom.—Mr Suringar pre-sented to the Academy a new (third) contribution to our knowledge of the Melocacti of the West Indies.

BOOKS, PAMPHLETS, and SRRIALS RECEIVED Lifet Themselved in the Company of the Com BOOKS, PAMPHLETS, and SERIALS RECEIVED

CONTENTS. P.	AGE
The Teaching of Forestry By Sir D. Brandis,	
F,R.8	265
The Applications of Modern Chemistry. By Sir H.	- 1
E Roscoe, M.P. FRS	268
The Fishes of Switzerland By Dr. Albert Gunther, FRS.	
The History of Marriage. By Prof. W. Robertson	269
	270
Our Book Shelf:-	-,0
Johnston-Lavis: "Geological Map of Monte Somma	
and Vesuvius"	271
Huxley "Les Sciances Naturelles et l'Éducation".	272
Letters to the Editor	
W. E Weber.—C Runge	272
Earthquake Shocks in Italy and Australia -R. L. J.	
Ellery, F.R S. Force and Determinism,Prof. Oliver J. Lodge.	272
	272
	273
The Identification of Templeton's British Earthworms.	-13
(Illustrated.)-Rev. Hilderic Friend	273
Copepoda as an Article of Food, Prof W. A.	-,,
Herdman	273
Are Seedling, of Hemerocallis fulva specially Variable?	
-Prof. Marcus M. Hartog	274
The Green Sandpiper - The Duke of Argyll,	
Liquids and Gases (With Diagram.) By Prof. W.	274
Ramesy, F.R.S	274
Experimental Researches on Mechanical Flight,	-17
Ry Prof S. P. Langley	277
On the Solid and Liquid Particles in Clouds By	,
John Aitken, F R.S	279
	280
	280
Our Astronomical Column:— A Cause of Lunar Libration	283
	283
	283
The Observatory of Yale University .	283
The Recent Epidemic of Influenza. (With Diagram.)	-
By Fredk, J. Brodle	283
The Museums Association	285
	286
University and Educational Intelligence	287

Societies and Academies .

Books, Pamphlets, and Serials Received . . .

THURSDAY, JULY 30, 1891.

THE HISTORY OF CHEMISTRY

A History of Chemistry from the Earliest Times to the Present Day. By Ernst von Meyer, Professor of Chemistry in the University of Leipzig. Translated by George McGowan (London: Macmillan and Co., 1891)

F all branches of natural science, none has a history more profoundly interesting or more fascinating than chemistry. And yet, strange to say, none has received less adequate treatment from the historian The reason for this comparative neglect is not far to seek. The historian of science must have qualifications which are rarely united in one man: not only must be possess the attributes of the successful writer on social, political, or economic history, but he must also be a past-master in the special branch with which he deals, and be well informed on all its cognate branches. Germany has given us the classical volumes of Kopp, from France comes the learned work of Hoefer; whilst in England we have had, until quite recently, to be content with the somewhat trivial, disjointed, and partial narration of Thomas Thomson In addition we have had a number of monographs, especially within recent years, on the labours of particular individuals; many of these, like Henry's "Dalton," Wilson's "Life of Cavendish," Bence Jones's "Life and Letters of Faraday," and the remarkable series of biographical sketches which we owe to the facile pen of Hofmann, are delightful works, but these, after all, are only mêmoires pour servir As a rule, the more formal and general histories which deal with the organized growth of the science are not very attractive; either their authors lack literary grace and charm, or they are superficial, ill-informed, and, in some cases, so obviously biassed as to render them altogether untrustworthy. And, moreover, not one of them has sought to grapple with the splendid achievements of the last halfcentury in any truly philosophic manner. Kopp and Hoefer have, between them, told us all that is known, or, in all probability, ever will be known, or need he known. respecting the beginnings of chemistry, and of its growth through the Middle Ages, and down to the end of the last century We now require somebody to set about doing for this nineteenth century what the German and French historians have done for those that precede it. The labour would be stupendous, but the result might be magnificent. At no period in the history of the science have its generalizations been more brilliant, and its theories more comprehensive, more prolific, and, it may be added, more securely established The birth of the century saw the extension of the atomic hypothesis to the explanation of the fundamental facts of chemical combination, and it has been the chief and most characteristic work of the century to place that theory on a foundation as sound and as firm as that on which the immortal conception of Newton is based. The historian of the chemistry of the nineteenth century need have no other text than that of the atomic theory; for round this dominant conception all other present-day theories are

ranged; it is the centre of a system which it vivifies and feeds, and by which it itself is fed and strengthened in return.

Some attempt at what is here foreshadowed has been made in the book before us, but, excellent as the work is in many respects, it is even more suggestive of what remains to be accomplished. The book is divided into six chapters, of which the fifth and sixth are devoted to the history of chemistry from the death of Lavoisier to the present time, and these two chapters occupy nearly threefourths of the volume This portion is not only the larger, but is confessedly the most difficult of the whole In weighing and criticizing current chemical doctrine. and in discussing the theories of the present, even the most conscientious historian is apt to be unconsciously biassed by the predilections and prejudices of his training and environment. Prof. von Meyer has not been unmindful of this possible danger, but after carefully reading his work we can heartily congratulate him on the success with which he has preserved the "objective attitude" which is essential to the true historian. As he tells us, it has been his earnest desire to shed a clear light upon the conflicting views respecting the development and importance of the chemical doctrines of to-day. and to endeavour to apply a calmer and juster criticism to the services of eminent investigators of quite recent years than has hitherto, in many cases, been meted out to them It is possible that we apprehend Prof von Meyer's meaning the more fully when we state that such a catholicity of sentiment and so judicial a temperament have not always characterized the occupant of the Chair of Chemistry in the University of Leipzig

For the two chapters which treat of modern chemistry we have nothing but unqualified praise, and we earnestly commend them to the attention of those students who desire to have a coup d'aul at once comprehensive and accurate of the meaning and tendency of present-day doctrine. When we have regard to the enormous mass of material which has to be systematized, and, as it were, brought within focus, some errors and omissions are inevitable. And it is possible that here and there a slight lack of balance and due proportion may be discerned . some matters have been treated at comparatively great length, whilst others have been but scantily noticed this point differences of opinion are sure to arise tot homines, tot sententice But no candid reader can fail to be impressed with the singularly fair and impartial manner with which Prof von Meyer has dealt with the labours of contemporary workers. It is a pleasure to read a work in which the writer has been superior to the petty Chauvinism which has disfigured certain historical productions of the last twenty years We would specially indicate the critical notices of the labours and services of Lavoisier, Berzelius, Davy, Dumas, Liebig, and Wöhler, as models of historical acumen, sound judgment, and rigid candour. On the time-honoured question, "With whom should rest the merit of the discovery of the composition of water?" Prof. von Meyer is scrupulously just and impartial. He shows that Lavoisier was so far dominated by his principe oxygine ou acidifiant that, in burning hydrogen, "he expected to find an acid as the product of its combustion, and therefore looked for one. It is the undisputed merit of the phlogistonist Cavendish to have

proved that water alone is produced by the combustion of hydrogen" (pp. 157-58).

Although he devotes only two chapters to it, it is obvious that it is the main purpose of Prof von Meyer's work to trace the development of chemistry from the downfall of phlogistonism onwards, and he has therefore only dealt with the earlier periods in order to give the reader a connected view of the growth of the science. This portion of the work is touched with a comparatively light hand, and in some respects compares unfavourably with the rest. Although at times there are graphic sketches-as, for example, in the account of Palissy's work, and in the estimate of Bergmann's services to analytical chemistry, and in the story of that strange compound of truculent charlatanry, gross mysticism, and strong common-sense, who called himself Philippus Aureolus Paracelsus Theophrastus Bombastus—the general impression is not wholly satisfactory, and to trace the historical connection of the several epochs presupposes more knowledge than Prof von Meyer imparts. It is hardly possible to do justice to the age of alchemy in 40 pages, or to the history of the latro-chemical period, which includes the work not only of Paracelsus and his school, but also that of Van Helmont, George Agricola, Palissy, and Glauber, in 30 pages But with the "Geschichte der Chemie" before him, Prof von Meyer may well have hesitated to plough with the patient heifer of Hermann Kopp

In his fourth chapter, where he deals with the period of the phlogiston theory, the author begins to expand somewhat, but occasionally, we venture to think, at the expense of strict historical accuracy Thus it is not strictly true to say that Kunkel laboured "for years" to discover the secret of the preparation of phosphorus (p. 141), or that Cavendish defended the phlogistic theory "with all his might" (p 118) That singularly austere and passionless person-that "cold clear Intelligence," as Wilson calls him-was utterly incapable of entering the lists as the champion of any theory He let his Irish friend Kirwan, to whom it was more congenial, do all the fighting It is hardly correct to describe the calm and philosophic Priestley as "eccentric and of a restless fiery nature." No man gave and got harder knocks in his time than did the kind-hearted, even-tempered old philosopher, he, too, did his fighting "all in the way of business," hitting straight and above belt, and with no malice in his blow, but to call him "eccentric," or "restless and fiery," reveals an entire misconception of his disposition and character The occasion of Lavoisier's admission into the French Academy is only partially stated, and it is not wholly true to say that amongst all his numerous friends and admirers only one chemist. Loysel, had the courage to protest against his execution (p 153)

A word in conclusion as to the manner in which Dr. McGovan has done the work of translation. His saim, be tells us, has been to reproduce clearly the sense of the German onginal, and in this he has, no doubt, succeeded admirably. But a purist might object that, in his efforts to preserve the sense, he has too carefully retained the tidom. To say that "the absorption of medicine in chemistry, the fusion of both together, was the watchword which emanated from Paracelsus" (or 3) is scarcely

a happy method of expression. Nor is this paragraph much better —

"Spirit of wine—the agua vita of the alchemists—continued to grow in importance during the intro-chemical age, as it had done in the alchemistic. This applied to it not merely from a theoretical point of view, as being a product of various fermentation processes to which much attention was paid, but also from a practical, since Paracelsus and his disciples used it largely in the preparation of essences and functures" (190 of essences and functures "(190 of essences and functures" (190 of essences and functures "(190 of essences and functures" (190 of essences and functures "(190 of essences and functures "(190 of essences and functures" (190 of essences and functures "(190 of essences and functures" (190 of essences and functures "(190 of essences and functures" (190 of essences and functures "(190 of essences and functures" (190 of essences and

On p. 10., Boyle's manor in Dorsetshire is erroneously called "Subfridge," and on p. 185 "Dalon" is in-correctly printed for "Davy." Such terms as "centre-point" and "fire-stuff" are not current English Dr McGowan's duty as a translator doubliess required him to say that "the nobility and poetry of his [Davy's] nature are shown both in the journals which he kept adming his extensive travels in France, Germany, and Italy, and in his beautiful relations to Faraday." (p. 187), but the veracious historian, familiar with the annals of the Royal Institution, would probably have expressed the Royal Institution, would probably have expressed.

PROGRESS IN ELEMENTARY BIOLOGY

Lesson: in Llementary Biology By T Jeffery Parker, B Sc, F R S, Professor of Biology in the University of Otago, New Zealand. (London Macmillan and Co, 1891.)

TOROF JEFFERY PARKER is to be congratulated on having produced an extremely well-written, well-considered, and original class-book. The teaching of so-called "elementary biology" has, in consequence of the coercion of examination schedules and the multiplication of little cram-books dealing with the selected and protected "types," become in this country a very poor thing. The practical work in the laboratory with frog, fern, rabbit, and worm, which was, when first introduced, a step in advance, has become, like so many other things which were good in their origin, a tyranny and an impediment to knowledge Students have resolutely shut their eyes to all facts but those presented by the schedule types, and teachers of a certain class have seen the easiest way to secure "examination results" in genoring the generalizations of biology, and in plying their pupils with the regulation details as to the few animals and plants scheduled for dissection Prof Parker's book should help to remedy this state of things His aim has been, he states, to supply the connected narrative which would be out of place in a practical hand-book. agree with him that the main object of teaching biology as part of a liberal education is to familiarize the student not so much with the facts as with the ideas of science. In this little book the student will find many of the most important conceptions of biological science set forth and illustrated, not by reference merely to the types which he dissects or examines with greatest ease in the elementary course in a laboratory, but by the use of a larger area of well-chosen examples, both of plants and animals. Original woodcuts, often of exceptional merit, are freely introduced in the text

Whilst the plan of Prof. Parker's book is excellent, I cannot help feeling some regret that he has not carried

it out on a somewhat larger scale, so as to make his volume represent for the blodgy of to-day what the classical "Comparative Physiology" of Dr Carpenter did for the blodgy and the properties of the thing the comparative Physiology" of Dr Carpenter did will be readed to—if it be a defect—is one which can very well be remedied beneafter, since the author will undoubtedly have an opportunity of expanding his book in every direction in a later edition in a later edition in a later edition.

Nearly half the book is devoted to the consideration of the phenomena of life as exhibited by unicellular organisms-the Protozoa and Protophyta There can hardly be any doubt that this is by no means an undue proportion, since it is unquestionable that in these simplest forms the fundamental problems of biology present themselves in the clearest light. We have well-illustrated chapters on Amœba, on Hæmatococcus, on Heteromita, on Euglena, on the Mycetozoa, and then a comparison of the foregoing organisms with certain constituent parts of the higher animals and plants, viz. cells. The minute structure and division of cells and nuclei are fully treated and well illustrated. Then follow separate chapters on yeast, on bacteria, on biogenesis and abiogenesis, and on the more complicated unicellular animals-the Ciliata. from among which are chosen Paramocium, Stylonichia, Oxytricha, Opalina, Vorticella, and Zoothamnium A chapter on species and their origin, and the principles of classification, comes next, the illustrative examples being chosen from among the Protozoa already described The Foraminifera, Radiolaria, and the Diatomaccæ are then brought under consideration. In every chapter the organism or group of organisms treated is made to serve as the concrete basis of a gradually expanding and connected narrative Thus, in passing to the consideration of such forms as Mucor, Vaucheria, and Caulerpa, the author savs -

"The five preceding lessons have shown us how complex a cell may become, either by internal differentiation of its protoplasm or by differentiation of its cell-wall. In this and the following lessons we shall see how a considerable degree of specialization may be attained by the elongation of cells into filaments?

A pause 13 now made, and a brief but thoroughly upto-date chapter 13 inserted on "the distinctive characters of animals and plants." Prof Parker thinks there 13 a great deal to be said in favour of Hackel's Ithrid organic kingdom—the Protista I do not agree with him in thinking that it is probable that the earliest organisms were "protists," and that from them animals and plants were evolved along divergent lines of descent

If we approach this question, not with the attempt to define plants and animals verbally, but with the object of indicating probable lines of descent, the groups once times considered as doubtful, and therefore "proting" take rank with great probability either in the animal or the vegetable series. The Mycetoron and the Volvocines fit quite naturally in the animal series, they would be isolated among the Protophyta, and, conversely, the Bacteriaces are inseparable from the Oscillatories and other filamentous green plant.

Prof Parker next proceeds to deal with plants of increasing complexity of structure and function—Penicillum, Agaricus, Ulva, Laminaria, and Nitella; ard, as a parallel to these in the animal series, we have two chap-

ters, with excellent woodcuts, on Hydra and on the Hydroid polyps, their colony-building and their alternation of generations The extremely important facts and theories of spermatogenesis and oogenesis and of fertilization are next set forth, briefly but clearly, and in sufficient detail for the general purposes of the book. In connection with the early development of the fertilized egg-cell of the Metazoon from its unicellular phase to the condition of the diblastula, the question is considered as to how we are to suppose that the passage took place historically from Protozoa to Metazoa or Enterozoa It is pointed out that there is a break here in the series of living animals known to us, whilst there is no correaponding break in the series of plants there we pass by insensible gradations from unicellular forms to linear aggregates of cells, and from these to superficial and to solid aggregates

The Mayosphara planula described by Haeckel in 1870 is cited as an animal tending to bridge over the wan in the animal series, but a footnote informs the reader that "unfortunately nobody has since seen this organism" Prof. Parker probably is awaie that this is also true of Haeckel's Protomy to aurantiaca, which he figures and describes in an earlier chapter. It certainly is to be regretted that neither of these interesting organisms has been observed again since they were de scribed by Haeckel However, Volvov globator is always with us, and Prof. Parker gives an excellent set of figures and a description of it, and proceeds to show how a twocell-layered sac-the ancestral gastrula or diblastulamight have been derived from such a colony. He also shows how a primitive diploblastic form might have developed from a multi-nucleate Protozoon, such as Opalina or Oxytricha.

In the laboratory it is convenient to take the Earthworm as an example of that central type of structure which is found under various modifications in all the Colomate animals Prof Parker, rightly separating himself from the ties of laboratory work, prefers the marine worm Polygordius for his illustration of this grade of structure, choosing it partly on account of its greater simplicity, partly on account of its extremely interesting and well-studied developmental history As the author contends, a student who reads the two chapters here devoted to the anatomy, physiology, and development of Polygordius, will have an immense advantage either in his subsequent study of the Earthworm, or in reverting to his notes of a previous dissection of that worthy beast The principle of the comparative method will be revealed to him, and he will learn to distinguish things essential from things non-essential

Next, with a rush, having scaled the long ladder leading to Polygordius, Prof Parker takes his reader in one chapter of seventeen pages through the anatomy and morphology of the starfish, the crayfish, the mussel, and the dogfish This seems and is rather rapid, but the rapidity is intentional and justifiable. By the and of this book the student is intended only to gain a general view of the structure of those animals as comparable to that of Polygordius. For further details he must go on to the special study of animal morphology, physiology, and embryology, or having studied these subjects more test, he man, by and of Prof. Farker's clever sche-

matic woodcuts, gain a wind impression of the unity of organization and the divergence in minor points of structure of the higher animals when compared one with another. Perhaps, however, in that enlarged edition of this blook which will are no distant date appear, For Parker will treat the higher animals less unceremonously, this he might do, and yet retain that conciseness and regard for the essential which form an admirable characteristic of his method.

Mosses and Ferns are treated as the parallel among plants of Polygordius in the animal series, and in a single chapter Equisation, Salvina, Selaginella, Opmosperms, and Angiosperms are surveyed (and excellently illustrated by finished woodcuts) in such a way as to give the student an accurate and highly effective survey of the restart features of orgestable morphology and physiology.

Such is the outline of these "Lessons". Their ment, however, consists not merely in the general plan, but in the fact that the author is an experienced teacher and an accomplished investigator, who has developed to a high degree the art of loud statement—one who is thoroughly familiar with the latest researches in the wide field of which he treats, and is able, whilst stering before his reader the most important generalizations of his science, to avoid redundancy, and to give a fresh and original handling to the oft-told story of the structure and functions of lying things.

E RAY LANKESTER.

CEREBRAL LOCALIZATION

The Crooman Lectures on Cerebral Localization By David Ferner, M.D., LL.D., F.R.S., &c With Illustrations (London. Smith, Flder, and Co., 1890)

In these valuable lectures, Dr. Ferrier reviews the subject of cerebral localization, so far as the representation of movement and of special sense is concerned. After referring categorically, in the first of the sense, to the historical experiments on the subject, arranged in order of chronological sequence, he points out the fundamental principles embodied in the term cerebral localization. Leaving the discussion of motor representation, he devotes the remaining five lectures to the consideration of the cortical representation of the special senses, beginning with that of sub-

The representation of sight is, according to all observers, mainly restricted to a definite area of the cortex The differentiation of that area and its topographical subdivision are points of the highest interest, and naturally do not escape discussion We are rather surprised, however, to find that Dr Ferrier is not prepared to admit that Munk and Schafer's experiments, besides those of other observers, establish visual representation to be situated in the occipital lobe, but is inclined to believe that the angular gyrus is the centre for clear vision mainly for the eye of the opposite side. Upon this we would only remark that it does not appear to us that the mass of evidence relating to crossed hemianopsia, whether of experimental or clinical nature, can be put aside as easily as Dr Ferrier would seem to consider possible, but those interested in the subject will find many of the facts bearing on this question referred to in his treatment of the points at issue.

So, too, with the representation of audition, while all (awar Schafer's and Sanger Brown's) observations support Dr Ferner's views of the seat of representation of hearing, it would undoubtedly have been better that the rebutting evidence brought against the exceptional facts referred to should have consisted of a number of experiments, and not of a single one, even although that seems to have been a very conclusive observation

After disposing of the centre of audition, the tactile centre receives attention, and is preceded by a discussion of the paths along which afferent impressions travel in the spinal cord to the higher centres. Of course, this subject has been very actively investigated by various observers for many years, but it has always appeared to us that sufficient attention has never been given to the simple consideration whether or not the lower centres are engaged in the transmission of such impulses. In the limited space at Dr. Ferrier's disposal he has evidently not been able to give this matter full discussion, and is therefore led to assume that Brown Scouard's dictum respecting the passage of afferent (tactile, not painful) impulses up the opposite side of the cord holds good This question is now being reinvestigated, and the preliminary observations published by Mott and others throw very grave doubt on the validity of this assumption, which has so long been accepted as final

As regards the representation of common tactile sensation in the cortex cerebri, Dr Ferrier discovered that it was probably represented in the hippocampal region, and he reviews the results of his experiments, as well to those of Schafer and Horsley, which tended to show that the gyrnis fornicatus, as well as the hippocampus, were the seat of tactile perception, and he concludes that possibly the whole limbic lobe is concerned with this representation

As regards, however, the representation of sensation in the exitable or motor part of the cortex, he will "have none of it." Here, again, we are afraid that the considerations of time and space, which always handicap subjects treated in lecture form, account for the fact that the critical examination of this question is not so complete as perhaps it might have been made

On the whole, these lectures well maintain the author's high reputation as a keen observer, and an indefatigable student, gifted with singular clearness and distinctioness of expression, and they will well repay perusal by all who wish to follow the progress of knowledge of corebral localization and its most important bearing.

OUR BOOK SHELF

Education and Heredity By J. M. Guyau (London. Walter Scott, 1891)

This small and excellently-translated work is a posthumous publication, written by a Frenchman who died four years ago at the early age of thuty-three. He was a fluent and prolife writer, the author of no less than fourteen other publications, and is described in the introduction as a philosopher and poet. It would seem from this book that the latter temperament was his prevalent the characteristic. Its prevalent hierary style and the originality both of metaphor and of handling will commend itself, and so will the account of recent hypotoic in-

vestigations, and the use made of them in the argument. Interesting and appropriate quotations are inserted from numerous authors of fame and notoriety, as from Plato, Decarates, Lebenitz, and Spencer, down to Toiston. But when, after reading right through the book, one asks when the control of the contro

"A forth clearly the state of t

inheritance is very slightly efficient

The following paragraph will serve as an example of what is least good in the author's style and method.— "Why then should not the representation of man, by hereditary tendency, excite in man himself a peculiar pleasure, and an inclination no longer of tlight, but to approach, speak, be helped, to put others in his place?
When a child falls under the wheels of a carriage, we precipitate ourselves to its rescue by an almost instinctive inovement, just as we should start aside from a precipice The image of others is thus substituted for the image of ourselves. In the scales of the inner balance, I, thou, are constantly interchanged. This delicate mechanism is partly produced by heredity Man is thus doinesticated, made gentler, and more civilized, now he is partially savage, partially civilized or civilizable. The result of education through the ages is thus fixed in heredity itself, and this is one of the proofs of the power possessed by education, if not always for the present, at least for the future "

Life is short, there is much to learn, and economy of time is important. It is questionable whether it is worth the while of a person who has some acquaintance with the subject of this book to spend half a working day in reading it, for he might not find it as nourishing as he would wish. Still it is not tulkley that those to whom the subject is unfamiliar would gain instruction from the book and would consider it throughout to be interesting.

The Soul of Man an Investigation of the Facts of Physiological and Experimental Psychology By Dr Paul Carus (London, Edward Arnold)

It is in vain that a puzzled reader seeks to discover, the unof this book. It is entitled "The Soul of Man," but no explanation is given as to what is meant by the title, and at the end of forty-sar rambling and discursive chapters on things in general, the reader finds himself no wiser. It is called "an Investigation of the Facts of Physiological and Experimental Fsychology," but there as anatomy, of embryology, of neorology, &c., are set forth, such in the form in which they can be found in elementary text-books on the subjects, but the facts this presented are not investigated, they are presented in now hight, no new conclusions are drawn from them, and the object of their presentation does not appear. Here the prefer he chains originally, he held for which instance, that consciousness (which he calls a concentrated or intensified feeling—an additional element that some-

times is, and sometimes is not, attached to mental operations) is "produced" in the corpus stratum. It does not appear, however, that this hypothesis leads anything, or has any appreciable bearing on the "problem anything, or has any appreciable bearing on the "problem thinks, too, that man has two souls, a central soul and a peripheral soul; and it is thus that he explanas the familiar fact that certain purposive actions are unattended with consciousness, but we cannot say that this explanasciable in the supplication of the supplication of

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents: Neither can he undertake to return, or to correspond with the writers of rejected manuscripts intended for this or any other part of NATURE No notice is taken of anonymous communications!

The Recent Earthquakes in Italy

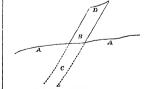
WITH reference to the letter which appears in your issue of big 33 (p. 27), on the earthquake, having occurred it Ventuus on June 7, and on the same day in Southern Australia, I would be supported by the same of the same of the same of Australia, I would warmly of a great circle which I call the "south-west coast of Australia great circle which I call the "south-west coast of Australia great circle which I call the "south-west coast of Australia great circle with a land to the about 370 of Catanaro, leaving Venurus about 65 miles to the north line great circle so one of maximum compression on the earth's surface—that is, it less for the most part on the occus surface—that is, it less for the most part on the occus surface—that is, it less for the most part on the occus surface—that is, it less for the most part on the occus surface—that is, it less for the most part on the occus surface—that is, it less for the most part on the occus surface—that is, it less for the most part on the occus surface.

It is also worth noting that, while you cate in the same is two shocks as having occurred in the Ardian Islands on June 24 (of these, Stromboli lies about 40 miles woulh of the direction of this great circle), there was recorded on that day, in the newspacers, an earthquade shock as having taken place on the 270 (midnight) at Christians, South Carolina, which lies about in question at this point, and therefore approximatively in the wintil,

Royal College of Science for Ireland, Stephen's Green, Dublin, July 24.

The Great Comet of 1882.

It your tout of May 38 (p. 81) is a communication about the contest of 1882 as seen in the act of passing close to the sun. As attention has thus been called to that count. I desure to report a remarkable penalinarity of the tail vs. whereved by myself. October 3, 1882, about daybreak. It was my first view of this glorous contest. Other persons on the east sales of the installs had seen contest. Other persons on the east sales of the installs had seen contest. Other persons on the east sales of the installs had seen contest of the penalinary of the tail, which was cut off tharply at an oblique angle, on an incurred then. The following representation is correct



from one in my note-book made at the time. AA represents the eastern ridge of the Kahakuloa canyon on the north end of Mans, where I was sleeping. B is the brilliant end of the vast tail like a scimutar blade, fully as bright as the moon. C is

copied from my note-book. It was evidently meant to indicate the continuation of the init towards the nucleus, as seen on minal edge of the tail, as sharp as the outer limb of the moon, and of fullest strength of lustre. Altogether it formed a rather papilling apparation Clouds soon obscured it. No farther yiew was obtained for two or three days, when the end of the tail had

was obtained for two or three days, when the end of the tau nau assumed the usual musty, indefinite outline The conclusion forced upon my mind was that the comer, having parted with its fall in its rapid turn at the per wall of water that heads a freshet in a stream. Another re-semblance suggested was that of the solid looking outline of an

up-rolling cumulus cloud

I will add hereto a statement made to me at the time by the Rev. Iliram Bingham, a distinguished pioneer missionary to the Gilbert Islands He saw the comet about a week earlier than myself, from Kancohe, on the east side of Oahu Both he and myeri, from kaneone, on the case sate of value 1 hours of and his wife observed ceaves of frishmats (colour) summing outcomed along the hrilliant tail. Mr. Bingham is a highly cultivated person, and having commanded the missionary ship for part of two years, is accustomed to lunar and stellar observation. I was led at the time to believe that there was no optical illusion in what he saw SPRENO E BISHOP

Honolulu, lune 30.

Copenoda as an Article of Food

PROF HERDMAN's practical demonstration at the North Cape confirms a theory I have long held, that the Copepoda, which abound in every ocean, sea, and lake, might and advantageously made available for human food

It is well known that the species Calanus finnarchicus, so abundant in our northern seas, forms the chief food of the Greenland whale our northern seas, forms the chief food of the Greenland whale to four wom immediate coasts about an in his and other equally four wom immediate to said should be sufficient to the control of Man, each pull of the tow net contained thousands of Man, each pull of the tow net contained thousands of mother and larger species of Coppoint, Ammodieve aparterisms, and Dr. John Murray has found that a still larger-species, Euchard and Dr. John Murray has found that a still larger-species, Euchard A number of finely methed trunks, used off the west coast of Ireland, would, I am convinced, furnats excellent food for starring multitudes in time of freed.

A propos of the distribution of Copepoda, my attention was called a few days ngo by the Mayor of Bootle to the filter-beds of the town salt water baths, which he said were swarming with Entomostraca The water is supplied direct from the river, of Inte (bown sate was the property of Coppeda an encommon quantities, the balk of them heing European alterants, a species only once before taken in Britan, and then in near proximity to Bootle Probably other filter beds are equally prolife, and may prove valuable hanting grounds, the Coppeda undoubtedly acting as exavengers in keeping the water pure from patrickets.

Liverpool, July 24.

Meteorological Phenomenon

I HAVE received in a letter from a friend residing in Bornston, Shropshire, the following account of a remarkably interesting meteorological phenomenon, which is well worth putting on

record — a cursous sight from this house yesterday [July 26] It was a dead caim, but in a field just below the garden, with only one hedge between us and it, the hay was whirled up high into the sky, a column connecting above and below, and in the course of the evening we found great patches of hay raining the course of the evening we found great patches. down all over the surrounding meadows and our garden. It kept falling quite four hours after the affair There was not a breath of air stirring as far as we could see, except in that one

Refraction through a Prism.

In such elementary text-books on geometrical optics as I have consulted it has always seemed to me that the writers have found a difficulty in presenting a precise direct proof of the theorem that when a ray is turned out of its course by direct

passage through a prism, its deviation is least when its path is symmetrical with regard to the prism.

May 1 ask you to consuler the simple proof which I inclose,

May I ask you to consider the simple proof which I inclose, and may I leave it to your judgment whether it is worth while that it should be presented to the notice of teachers in the pages of NATURE? My knowledge of text-books I cannot suppose to be exhaustive, and the arrangement of the proof which I inclose

TOHN H KIRKBY. Radley College, Abangdon, June 11

of course may not be any novelty.

Menmum Deviation.

The problem is to find two rays which, passing directly through a prism near together, have their directions changed by the prism to the same amount—for in the limit, these, when brought into coincidence by change of position of the prism, will mark the course of that ray which suffers minimum deviation (experiment may be appealed to, to show that it is minimum

and not maximum) Let ABCD be the course of a ray of hight through the prism whose vertex is V. At B make the VBC' = 4 VCB, then if the ray BC' is continued out of the VBC = 4 VCB, then if the ray BC is continued out of the prism on hoth sides, it is evident that its completion DC'BA' meets and leaves the faces of the prism at exactly the same angles as the original ray ABCD, only in the opposite direction. Thus the two rays A BCD, ABC D' suffer equal deviation, and because the Δ×VBC, VCB are similar,

and when the rays are so close as to practically render C, C' co-incident, we have $VB^2 = VC^3$, or VB = VC when the devia-tion is a minimum, $i \in t$ the deviation is a minimum when the course of the ray makes equal angles with the sides of the

[Oxford men will remember that more than twenty years ago Prof Clifton gave a somewhat similar proof as follows —
Since the paths ABC1) and D'C'BN are similar, if one is a
path of minimum deviation the other must have the same property also Hence, since light can always travel in the reverse direction along a path, the paths

ABCD and NBC'D

are both paths of minimum deviation

But the existence of two such minima is contrary to experi-ment. Hence the paths must be identical, which can only be the case of the angle VBC = VBC' = VCB - ED.]

Further Notes on the Anatomy of the Heloderma.

SINCE I published in NATURE (vol. alin. p. 514), "The Poison Apparatus of the Heloderma," there has appeared from the pen of Mr Boulenger another notable contribution to the pen of Mr. Boulenger another notable confribution to the anatomy of that genus of repities, entitled "Notice on the Osteology of Melode ms. horrsdam and M. anpfertum, with the Vertebree of the Lacritin, "If 2.5..., January 2.0.. 1891. That paper is especially useful, insamuch as it critically compares the vertebral columns of the two speces of Lazards under consistence of the Compare of the Compares the C he assigned to them in 1884, in feel to pass some observations. In concluding this notice I am led to pass some observations. In concluding this notice I am led to pass some observations are considered to the passer upon my memor on the anatomy of II superium when apparent in the Free of the Zool Soo of London in 1890. His criticism of my description of the alias of II superium is well as the contract of the criticism in the criticism of my description of the alias of II superium is well and the my description of the my direct of the context opening of the criticism is not of the criticism in the context opening of the criticism is not of the criticism in the criticism of the criticism is not only as the criticism is not only as the criticism is not of the criticism in the criticism in the criticism is not only as the criticism in the criticism in the criticism is not only as the criticism in the criticism in the criticism is not only as the criticism in the criticism in the criticism is not only as the criticism in the criticism in the criticism is not only as the criticism in the criticism in the criticism is not only as the criticism in the criticism in the criticism is not only as the criticism in the criticism in the criticism is not only as the criticism in the criticism in the criticism is not only as the criticism in the criticism in the criticism is not only as the criticism in the criticism in the presentation in the presentation plane, when the skell is perfect. In so far as the found of the criticism is not in the leaders, and they always the longer, when the skell is perfect. In so far as the found is the criticism in the criticism in the criticism is not only the criticism and criticism in the criticism is not into always the longer, it believes no little allowance must be made for the criticism in the criticism in the criticism in the criticism is not into always the criticism in the criticism in the criticism in the criticism in the criticism is not the criticism in the criticism in the criticis

It would appear that it is to be the face of the Histoiremotoides to have their morphology more thoroughly worked out than most, or even any other, lizardd up to the present time, and I am given to understand that Frof, Garman, of Harvard College, or the state of Histoire the entire structure of Histoire than the the contract which was the structure of Histoire than the

THE DISCOVERY OF THE STANDARDS OF 1758.

THE discovery by the Clerk of the Journals of the House of Commons, referred to in NATURE last week (p. 280), of the original standards of length, which were in 1738 deposated in the custody of the Clerk of the House, has attracted some attention to the history of these Parlamentary standards. As some misapprehension as to the effect of such discovery appears to have arisen, and as it is to eminent men of science that we mainly indebted for our standards of length, the readers.

The standards of length above referred to were made under the directions of a Committee of the House of Commons, of which Lord Carysfort was Chairma, appointed on May 26, 1758, "to inquire into the original standards of weights and measures in this kingdom." The Committee reported that in 1742 several members of the Royal Society were at great pains in taking an exact measure of the ancent Exchequet standards of length of

Henry VII. and Queen Elizabeth), then condemned by the Committee as being coarsely made and "bad standards" that such measure was made by "very curious instruments prepared by the late ingenious Mr. Graham", and that the Royal Society had lent to the Committee a brass rod made pursuant to these experiments, which rod had been com-pared by Mr Harris, of the Royal Mint, with the Exchequer standards Mr Harris advised the Committee that the Royal Society's standard was made so accurately, and by persons so skilful and exact, that he did not think it easy to obtain a better standard; and accordingly the Committee then had two rods made by Mr Bird, an optician, according to Mr Harris's proposal, which "rods" were laid before the House The rod marked "Standard Yard, 1758," was to be taken as the proper standard, it was stated by the Committee to be made of brass, to be about 38 or 39 inches in length and about one inch thick, near to each end of the rod a fine point and line being drawn on a gold stud, the distance between the points on the gold study the "true standard length of a yard, 36 inches The second rod was made in the same manner as the first rod, excepting that it had " two upright cheeks" instead of points or lines, so that any other yard rod might be measured by being placed between the cheeks Both these rods (together with three standard troy pounds

marked "T," with a crown and "G.2," and a set of troy

1758
standards from 2 pounds to 32 pounds, made and adjusted
by Mr Harris "with very curious and exact scales of his
at the Mint") were stated by the Committee to be then
deposited with the Clerk of the House of Commons

in 1838 the attention of the Government was directed to the necessity of determining a new standard weight and measure to replace the above standards of 1758, which were stated by the Chancellor of the Exchequer-in a letter to Mr. G. Airy, the Astronomer-Royal—to have been "destroyed by the burning of the Houses of Parliament," and a Commission was appointed to restore the standards. The Commission included F Baily, J E D Bethune, Davies Gibert, J S Lefevre, J W Lubbock, Geo Peacock, R Sheepshanks, J Herschel, and G B Airy Their report of 1841 gives a precise description of the condition of the standards at the Journal Office immediately after the fire. The Committee reported that the legal standard of one yard was " so far injured that it was impossible to ascertain from it with the most moderate accuracy the statutable length of one yard", and also that the "legal standard of one troy pound was missing" New Parliamentary standards of length and weight were accordingly made under the directions of the Committee, and were legalized by an Act of Parliament passed in 1855. These new Imperial standards are now deposited with the Board of Trade, but legal "Parliamentary copies" of them are stated to have been immured, in 1853, in the House of Commons, and further copies were then deposited at the Royal Mint, the Royal Observatory, and with the Royal Society These latter Parliamentary with the Royal Society These latter Parliamentary copies are legally required to be compared with each other once in every ten years, but those deposited at the House of Commons are excepted from any such comparison. It would appear, however, that the House of Commons standards are sometimes examined, as is shown by some printed correspondence on this subject which was laid before the House of Lords in 1872, in which year the standards were examined, and after their examination were again immured in a wall near the lower waiting hall of the House of Commons; a certificate of

the deposit of the standards being given as follows—
"It is hereby certified that this day, in the presence of
the undersigned, the oaken box containing the Parlamentary Copy No. 4 of the Imperial Standard Vard,
and the Imperial Copy No 4 of the Imperial Standard
Pound," . . has been "deposited within the wall on the right-hand side of the second landing of the public the right-hand side of the second landing of the public staticase leading from the lower waiting hall up to the Commons Committee Rooms, a brass plate having been fixed upon the wall bearing the following inscription in Elizabethan or church text—Within this wall are de-Elizabethan or church text —Within this wan are de-posted standards of the British Yard Messure and the British Pound Weight, 1853. The certificate is signed by G B Airy (Astronomer-Royal), John George Shaw Lefevre (Clerk of the Parliaments), W H Miller, C P. Fortescue (President of the Board of Tradel, H W. Chisholm, and H. J Chaney; and is dated March 7,

It hardly appears, therefore, that the old standards of 1758, which appear to have remained unnoticed for the past fifty years, are now of any importance for the purposes of measurement.

MAXWELL'S ELECTRO-MAGNETIC THEORIES

A N account of Maxwell's electric theories from the pen of Prof Poincaré could not but be full of interest. The volume before us is the first of two on the views and conclusions set forth in the " Electricity and Magnetism" regarding electro static and electro-magnetic action, and their verification by Hertz and others, and we must of course wait for the completion of the work before we can form any adequate idea of its scope and character. and fully understand the results of the critical analysis which it contains But in spite of the fact that the treatise is in the somewhat disadvantageous form of an edited course of lectures, it is a contribution of great value to the literature of the subject. Whether or not it is possible always to agree with the physical views expressed regarding matters which are not yet outside the region of speculation, it is impossible not to admire its style and methods. Here are to be found exemplified that order and harmony which render the work of the best French mathematical writers so exquisitely clear, and that artistic charm which is so seldom seen in the writings of scientific men of other nationalities It has been remarked by competent critics that Maxwell's work, though essentially that of an artist and man of genius, is obscured here and there by a certain vagueness and want of logical coherence and completeness, which has tried the patience and strength of many a devoted disciple This was of course to a great extent inevitable. He sought out new fields of speculation for himself, and his greatest and most successful generalizations were, one cannot help feeling, the results rather of unerring intuition than of any completely systematic process of reasoning. Those who follow in his foot-teps therefore are glad of the help of any friendly guide who is able by his experience and strength to point out the dangers and diminish the diffi-culties which attend their progress

In his introduction Prof Poincaré gives a critical

estimate of Maxwell's theories which strikes one at first

sight as somewhat inappreciative Thus he says —
"La première fois qu'un lecteur français ouvre le livre de Maxwell, un sentiment de malaise, et souvent même de défiance se mêle d'abord à son admiration. Ce n'est qu'après un commerce prolongé et au prix de beaucoup d'efforts, que ce sentiment se dissipe. Quelques esprits éminents le conservent même toujours. ouvrant Maxwell un Français s'attend à y trouver un ensemble théorique aussi logique et aussi précis que l'optique physique fondée sur l'hypothèse de l'éther, il se prépare ainsi une déception que je voudrais éviter au lecteur en l'avertissant tout de suite de ce qu'il doit chercher dans Maxwell et de ce qu'il n'y saurait trouver.

1 "Électronté et Optique " I. Les Théories de Maxwell et la Théé Électromagnétique de la Lumière. Par H. Poincaré, Membre de l'Insui (Paris Georges Carré, 1890)

%NO. 1135, VOL. 44]

"Maxwell ne donne pas une explication mécanique de l'électricité et du magnétisme : il se borne à démontrer

que cette explication est possible.

"Il montre également que les phénomènes optiques ne sont qu'un cas particulier des phénomènes électromag-nétiques De toute théorie de l'électricité on pourra donc déduire immédiatement une théorie de la lumière.

"La réciproque n'est malheureusement pas vraie, d'une explication complète de la lumière, il n'est pas toujours aisé de tirer une explication complète des phéno-

mènes électriques."

The author, however, shows throughout his exposition that he is not only impressed with the extraordinary importance of Maxwell's work, but also thoroughly appreciates and admires, if occasionally under protest and with longing after the more ancient classic models, its somewhat wild and native beauty

An important part of the introduction is an exposition of the theoretical basis of what Prof Poincaré rightly regards as the fundamental idea of Maxwell's treatment of electro magnetism- that is, the application of the general processes of dynamics to any system of current-carrying conductors No doubt almost all the work which had been done previously had been more or lessof this nature, but we refer here to the attempt which Maxwell made with very considerable success to correlate electro-magnetic phenomena by means of Lagrange's general dynamical equations

In the Lagrangian method the physical state of a system is defined by means of certain parameters q_1, q_2 system is defined by means of certain parameters g_{11} , g_{22} , g_{31} , g_{32} in number, and a dynamical explanation is obtained, or proved to be possible, when the values of these parameters are found in terms of, or proved to be related to the positions and motions of a system of con-

nected particles, either of ordinary matter, or of some

If $m_1, m_2, \dots m_p$ be the masses of these particles, x_i, y_i, z_i , the Cartesian co-ordinates of the particle of mass m_i , and if the system have potential energy V, a function of the 3p co-ordinates of type x_i , y_i , z_i , there are 3p equations of motion of the form

$$\begin{array}{c}
m_i x_i + dV/dx_i = 0 \\
& & & & & & \\
& & & & & & \\
\end{array}$$
(1)

The kinetic energy T is

$$\frac{1}{2}\Sigma m \left(x^2 + y^2 + z^2\right),$$

and the principle of conservation of energy gives T + V = constant

Now we know V, and can express the co-ordinates of each particle or molecule in terms of the n parameters gu, g,, q,... The celebrated Lagrangian equations in terms of the parameters can then be obtained by direct transformation of (1), and are of the type

$$\frac{d}{dt}\frac{\partial \mathbf{T}}{\partial q_k} - \frac{\partial \mathbf{r}}{\partial q_k} + \frac{\partial \mathbf{V}}{\partial q_k} = \mathbf{0}$$

Here T and V are homogeneous quadratic functions, the first of the quantities of type q, with coefficients which are functions of the parameters themselves, the latter of the parameters only

If we have reason to believe that the system we are

dealing with is a dynamical system, for which the values of T and V (or, more properly, those parts of the total kinetic and potential energies which are concerned in the special phenomenon treated), can be obtained by observation of parameters of type q, we can use these equations in our discussions of results, whether or not we can actually express the parameters in terms of co-ordinates of particles of the system The justification of this process is the agreement of the results with experiment.

If now we imagine a system of particles (whether of

actual or hypothetical matter) say ø in number, which has the required values of T and V, and which further gives the same relations of the parameters ø, we have obtained a dynamical explanation of the phenomenon Prof Poincard remarks with respect to this process that no dynamical solution of the problem obtained in this way can be unique, and that in fact it must be possible to obtain in this way an infinite number of different solutions, or to quote his own words:—
"If any phenomenon admiss of a complete mechanical "if any phenomenon admiss of a complete mechanical"

"If any phenomenon admits of a complete mechanical explanation it will admit of an infinite number of others which equally well account for all the results of expen-

mention and the second of the second of the second of physical inquiry. Theorem remonsterin with one another are elaborated by different persons, and explain the known facts owell that there is hardly anything left to decide which is right. For example, according to Fresnel the direction of vibration in a ray of plane polarized light is perpendicular to the plane of polarization, according to Neumann and Mucc ullagh it is in the plane of polarization. It can hardly be said that any perfectly absolute experimentum crusts has yet been found to decide between these two theories, although the other second of the vew of Fresnel.

It is, however, to be remembered that while we can and different mechanical theories to explain the facts, the theories are not necessarily distinct, the mechanism of the facts which must be performed by the actual mechanism whatever that may be always is, as the above cited case well illustrates, a unity connecting the different explanations and a consequent element of similarity among them, and each sutvitactory modes of deciding in what respects it is redundant or madeounted.

The difficulty then as to real mechanical explanations of phenomena does not present us from making progress in our knowledge of matter. The Lagrangian method, and this is its remarkable intent, enables us to use the parameters instead of the co ordinates of actual particles, and thereby to predict the extence of further properties and thereby to predict the ordinates of actual particles, and thereby to predict the further ordinates of actual particles, and thereby considerable of the constraint of the properties observed. In this way may be lightened the task, happing to the constraint of the properties of the particle of the properties of the properties of the particles of the properties of the particles of the properties of the particles of the particles of the properties of the properties of the properties of the properties of the particles of the properties of the particles of the particl

There seems, however, no doubt that Prof. Pomerar's correct in his view that the central idea of Maxwell's treatise is to prove the existence of a mechanical evplanation of electrical phenomena, not indeed actually inding it, but by showing that the Lagrangian method, which presupposes such an explanation, is applicable, and leads to consistent results

Coming now to the detailed exposition of Maxwell's theories, the first thing that calls for notice is the theory of electric displacement. This has always been a subject of considerable difficulty. What is electricity is it the placement of the considerable difficulty what is electricity is it the placement and representation of the considerable displacement and electric force remain simply analysis to the strain and stress in an elastic solid, and it can hardly be said that anyone has yet brought them out of the other displacement and electric force remain simply analysis to the strain and stress in Mo doubt the mechanical hardly be said that anyone has yet brought them out of the other displacement and electric force remain simply analysis of the other displacement and the strain of the other displacement and the strain of the other displacement and the other displacement and the strain of the other displacement and the strain of the stra

its on this account that Maxwell has abstained from giving such illustrations in his ireatise. On the other hand, some notion corresponding to that of electric displacement is necessary for any theory of electrical action regarded as propagated through a medium surrounding the electrified bodies, whose charges become thus the surface manifestation of the state of constraint set up in the dielectric by the electrification.

Prof Pomcaré distinguishes between two fluids—one which he calls electrizity, and the other the fluids statu-teur. Both fluids are incompressible, the latter fills all delectric space, the former is capable of being produced at or placed at any given place or on any given surface at or placed at any given place or on any given surface introduced, as, for example, when a change is pliced on the surface of a conductor, an equal quantity of the fluids fundateur is forced out across the boanding surface. When all the conductors of a system are in the neutral state, the fluids fundateurs is normal equilibrium, when, on the other hand, the conductors are electrified, the outpulbrium causes to be normal and the state becomes

There is some advantage in thus distinguishing between the fluid constituting the electrification and that filling the surrounding space, as it avoids some difficulties of explanation and treatment which arise when only one

On this result Frof Youncar' remarks that, although it agrees very well with the observed attractions and repulsions between electrified bodies, yet if these attractions and repulsions. The to be considered as due to the evistence of for that medium must be very different from those for fordurary substances. In electromotive force at a point correspond to the strain and electromotive force at a point correspond to the strain and stress in an elastic solid, but, for corresponds one different form of displacement and electromotive force at a point correspond to the strain and stress in an elastic solid, but, for corresponds one different form of displacement in the properties of the strain and stress in an elastic solid, but, for corresponds one different form of displacement or strain than any that have yet been imagined.

A difficulty here arises to which Poincaré attaches considerable importance. The potential energy in the medium is, if f_i , g_i , h be the component electric displacements, given by the equation

$$W = \int_{V}^{2\pi} (f^{2} + g^{2} + h^{2}) dv,$$

where dv is an element of volume and the integral is hypothesis as to the localization of the energy of the field, the amount contained in an element dv at which the displacements are f, g, h, is

$$K^{2\pi}(f^2 + g^2 + h^2)d\tau$$

or KF340/8w Consequently, if Fbe increased to F + dF, there will be an increase in the potential energy of amount 2KFdFdet/8m. If now the stresses act in the medium as ordinary stresses, they must produce corresponding strains in each element of volume. Hence if the element dv be a rectangular parallelepped of edges δ_1 , δ_2 , δ_2 when the field is free from electric stress, these dimensions will become, when an electromotive force F is produced at the element, respectively δ_1 ($1 + \epsilon_1$), δ_2 ($1 + \epsilon_2$), δ_3 ($1 + \epsilon_3$) fielder, if when F

is increased to F + dF, ϵ_1 , ϵ_2 , ϵ_3 become ϵ_1 + $d\epsilon_1$, ϵ_2 + $d\epsilon_3$, ϵ_3 + $d\epsilon_4$, the work done by the stresses will, neglecting small quantities of the second order, be

$$KF^{2}_{-8}dv(de_{1}-de_{2}-de_{3});$$

and if the increase of potential energy in the element take place in consequence of the work done against the stresses we get the equation

$$\frac{F^2}{8\pi}dv(de_1-de_2-de_3)=\frac{2FdF}{8\pi}dv,$$

-

298

$$de_1 - de_2 - de_3 = \frac{2dF}{F}$$
,

which gives by integration

$$e_1-e_2-e_3=2 \log F + \text{const.}$$

This result is inadmissible, since when F is zero, we must have $e_1 = e_2 = e_3 = e_3$ while if this equation holds either e_2 or e_3 is infinite

A solution of the difficulty is simply that the energy is not really potential but kinetic. It is certainly not easy to see why the electro-magnetic energy should be regarded as kinetic and the electro-static as potential, and it seems more natural to conclude, as all progress in knowledge of matter seems to indicate, that the properties of the medium are wholly due to motion

After a short sketch of purely magnetic theory, Ponnard proceeds to what must be regarded as the most important part of his account of Marwell's work—the theory of electro-magnetism. His investigation of the theory of electro-magnetism. His investigation of the from that usually given. Maxwell takes as his starting point here the equivalence of a current-carrying circuit of small dimensions and a magnet. Ponicaré bases his method directly on the following there results of experimental dimensions and a magnet conduction of experimental control of the properties of

With the assumption that the components of the force acting on a magnetic pole are obtained by partial differentiation of a function which depends only on the relative positions of the pole and the circuit, the usual theorems are obtained in the following elegant manner First of all it is shown that the potential of a closed plane circuit at any point in its plane is zero. This is first proved for a circuit symmetrical about a line on its own plane and a point on the axis of symmetry. Then by using the first fundamental proposition to introduce across the circuit straight conductors each carrying two equal and opposite currents equal to the current in the circuit, a circuit of any form is divided into narrow portions each bounded at the ends by elements of the circuit, and at its sides by radial lines passing through the point in question By using then the second proposition to replace each end-element of the circuit by a circular arc passing through the centre of the element and described from the given point as centre, each strip is turned into a complete circuit, symmetrical about a line through the given point. Since, then, the theorem is true for every such circuit, it is true for the whole given circuit which they build up. Next it is easily shown that when a circuit is situated on the surface of a cone but does not surround the axis—that is, is such that a generating line meets the circuit in an even number of points—the potential of the circuit at the vertex of the cone is zero. For, by means of conductors introduced along generating lines, and carrying equal and

opposite currents as before, it is possible with the aid of the second result stated above to replace the circuit by a number of narrow plane circuits each carrying the given current, and symmetrical about a generating line of the cone. Hence each element produces zero potential at the vertex, and therefore so also does the given circuit.

[JULY 20, 1801

vertex, and therefore so also does the given circuit.

One, and hassing through the axis, produce equal and opposite potentials at the vertex, if the currents are equal and flow in opposite directions round the cone. For by means of hypothetical conductors introduced as before along the generating lines, and the second fundable and the sense of the sense

Considering now any closed circuit, we can draw a cone from any chosen point as vertex, so that the generators pass through the circuit. Then this cone can be divided into an infinite number of infinitely small superposable cones of equal solid angle, each having a current flowing round it in the same direction as that round the given circuit, and the total potential at the common vertex is the sum of the equal potential is produced by three small circuits—that is, the potential is the circuit.

The equations connecting the components u_i, v_j, w_j of currents with the components of magnetic force and magnetic induction, the relations connecting the magnetic force and magnetic miduction, those connecting the magnetic force with the vector potential (which Foincaré calls the moment identermagnetique), and the value of the components of the latter quantity for a linear circuit with their application to the proof of Neumann's expression for the "electrodynamic potential" (the mutual intrinsic corresponding expressions for the "electrodynamic potentials" (electrokinetic energies) of the circuits themselves, are dealt with in the next two chapters

In chapter we we come to the most important part of the book, the theory of induction, and the treatment of this part of the subject is instructive. It is a result of the subject is instructive. It is a result of experiment that if the currents γ_1 , γ_2 in two fixed circumstructive. It is a result of experiment that if the currents γ_1 , γ_2 in two fixed circumstructives forces of $Ab\gamma_0 dt + Bb\gamma_0 dt$, $Bb\gamma_0 dt$, $Ab\gamma_0 dt$,

$$T = \frac{1}{2}(L_1\gamma_1^2 + 2M\gamma_1\gamma_2 + L_1\gamma_2^2),$$

 $\partial T = \frac{1}{2}(\gamma_1^2 dL_1 + 2\gamma_1\gamma_2 dM + \gamma_2^2 dL_2).$

so that the former work is

Thus the work dW done in virtue of the changes of the currents is the difference between this and the excess of

the energy given out by the batteries over that spent in heat. Thus

 $dW = E_1 v_1 dt + E_2 v_1 dt - R_2 v_2 dt - R_3 v_3 dt - \partial T;$

and this is the work done in virtue of changes of the and this is the WORK done in virtue of changes of the currents. This quantity must be a perfect differential, since its integral vanishes for a closed cycle of changes. The condution which must hold for this enables the values of A, B, C to be identified with -Li, -M, -L₂.

Maxwell's introduction of Lagrange's dynamical method into electro-magnetism is, as has been already stated, regarded by Poincaré as of great importance, and as he says "nous touchons ici à la vraie pensée de Maxwell."
After finding by this method the inductive electromotive forces, and the electro-magnetic forces, he proceeds to discuss Maxwell's theorems of the electro-magnetic field, and their crowning generalization, the electro-magnetic theory of light Except here and there, the treatment differs only in points of detail from that of Maxwell.

With regard to the equations of currents.

$$u = CP + \frac{K}{4\pi} \frac{\partial P}{\partial t}$$
,
&c. &c.

a difficulty is pointed out as to the specific inductive stance the first term must preponderate, and so K must be small, whereas K is generally regarded as very great in the case of a conductor It is worth noticing that this is really only a conventional means of explaining the impossibility of charging a condenser the space between the plates of which is filled with conducting substance, the true explanation is, no doubt, very different

The discussion of the experimental verifications of the electro-magnetic theory of light contains references to several lately-established experimental facts (apart from Hertz's experiments, which are reserved for special treatment) which bear on the theory For example, it has been shown by Curie that dielectrics, when tabulated in the order of increasing conductivity, are on the whole arranged (as obviously they should be) in the order of diminishing diatherinancy. Further, ebonite, which is opaque to light, is very permeable to dark radiations of longer period, which agrees with its high transparency to electrical waves

Again, it is remarked that the results of the electromagnetic theory with regard to reflections from the surface of glass and of metals lend a general support to the theory, while the disagreement in the values of the numerical constants as regards the want of magnetic permeability is referred to the frequency of the vibrations and the fact that the magnetization of the medium is not instantaneously produced

A marked feature of M Poincare's treatise is the chapter on rotatory polarization, in which he discusses the phenomena of rotation of the plane of polarized light by the action of a magnetic field. Although the essential difference between this effect and the apparently similar action of quartz, sugar solutions, &c, is pointed out, the author does not appear to lay stress on it as throwing light on the difference between their causes For example, after giving Airy's differential equations, for the propagation of the two rectangular component displacements, ξ , η , of a circularly polarized wave travelling along the axis of x, in the form

$$\begin{split} &\rho \frac{\partial^{4} \xi}{\partial \tilde{t}^{2}} = \frac{\partial^{2} \xi}{\partial z^{2}} + a \frac{\partial^{2} \eta}{\partial z^{2} \partial \tilde{t}^{2}}, \\ &\rho \frac{\partial^{2} \eta}{\partial \tilde{t}^{2}} = \frac{\partial^{2} \eta}{\partial z^{2}} - a \frac{\partial^{3} \xi}{\partial z^{2} \partial \tilde{t}^{2}}. \end{split}$$

NO. 1135, VOL. 44

can be obtained, which agrees with experiment, and after comparing the results of these equations with those of

other proposed equations, he says .-"Mais si le concordance de la formule avec l'expérience justific l'intioduction des derivées + 2 1/02201, - 21E/02101 dans les secondes membres des équations du mouvement d'une molécule d'éther, aucune considération théorique ne préside au choix de ces dérivées à l'exclusion des autres ; on ne possédait donc pas encore de théorie de la polarisation rotatoire magnétique"

This certainly seems rather too strong a statement in the face of Thomson's dynamical theory outlined in his "Electrostatics and Magnetism," and further claborated in Maxwell's treatise

Thomson's views on this subject are of the most fundamental importance, as they point to motion of, or in, the medium occupying the magnetic field as the cause of the magneto-optic effect discovered by Faraday, and to a certain structure of the substance as producing the phenomena shown by quartr, syrup, &c One of the most interesting passages of his lectures on molecular dynamics, delivered at Baltimore in 1885, is that in which he accounts for the observed results by the presence of rotating particles, "gyrostatic molecules," in the medium

It is obviously suggested by the gyrostatic investigation that it ought to be possible to explain the magneto-optic rotation in the electro-magnetic theory of light as a consequence of the presence of small magnets embedded in the vibrating medium with their axes in the direction of the ray, and therefore producing a component of magnetization in that direction. It is stated by M. Poincaré that a theory of this kind has been proposed by M. Potier, and published in the Compter Rendus The theory itself is not given, but the differential equations obtained are quoted, and are of the required form, and lead to the known experimental result 1

Maxwell's molecular vortices theory is, however, given, and certain difficulties which it involves discussed. The theoretical results of Hall's experiment are also given in theoretical results of trains experiment are also given in this connection, and Kerr's experiment proving the pro-duction of elliptic polarization by the reflection of plan-polarized light from the pole of a magnet is cited, but without any statement of the theory of the effect which has been worked out, principally by Fitzgerald. With regard to the explanation of the Hall effect by strain of the conducting film produced by the magnetic field, it has always seemed to me that it ought to be possible with proper appliances to decide the question, by experi-menting with a sufficiently powerful and uniform magnetic field

The work, it ought to be stated, concludes with an interesting chapter by the editor, M. Blondin, on experimental verifications of the theories of Maxwell This comprises the chief determinations of specific inductive capacity, Kerr's classical researches, and lastly, the interesting investigation inade by M. Rontgen of the electro-magnetic action of currents of displacement Of Prof. l'oincaré's second treatise on the experiments

of Hertz, &c. I hope shortly to give an account as a sequel to the present article A. GRAY

THE ORIGIN OF THE FLORA OF GREENLAND

LIOW the present flora of Greenland originated, is a question of great interest to British botanists and geologists, for the answer will probably help to solve the difficult problem, What was the origin of the recent flora of Britain? The flora of Greenland is so poor in species and has been so well studied that its relationship to the floras of Europe and America ought not to admit of much

from which a formula for the rotation of the plane of polarization of plane-polarized light in a magnetic field account of the present of the plane of polarization of plane-polarized light in a magnetic field account of the present of the plane of the

debate; yet we find that an active discussion is now going on among Scandinavian botanists as to its eastern or western affinities Sir J D Hooker, in his "Outlines of the Distribution of Arctic Plants." made a careful analysis of the species found in Greenland, and came to the conclusion that the relationship was more European than American, and this view seems to have been generally adopted by botanists. In a recent official report, contained in the valuable series of memoirs published by the Commission for the Exploration of Greenland, Prof. E Warming, however, has tried to show that the flora is American, and as this author has had access to fuller materials than were formerly available, his opinion will carry considerable weight Prof. A G Nathorst, a botanist especially competent to speak on questions relating to the botany of the Arctic regions and on the relation of the recent Arctic flora to the Glacial epoch, objects altogether to Prof Walming's conclusions, and, although dealing with the same materials, maintains attough desing win the same materials, maintains the accuracy of the generally accepted view as to the European relationship of the vegetation. It has certaily examines the flora in a way that has never been done before, and points to its dependence on bygone conditions. To certain of 1 Prof Nathorst's observations and conclusions I should like to draw attention

The principal result arrived at by Prof Warming was that the boundary between the American and the European provinces is formed by the Denmark Strait (the strait between Greenland and America), and not by Davis Strait as botanists have generally thought This conclusion Prof Nathorst critically examines, and so many curious and suggestive facts relating to geographical distribution come out in this examination that I may be unation to the out in this examination that 1 may be excused for referring to ceitain of them somewhat in detail. The flowering plants of Greenland include 386 species, none of which are confined to that country. Leaving out of security control to the country. eaving out of account circumpolar forms, Prof Warming finds in the list 36 characteristic western against 42 eastern species, but suggests that when the flora of Aictic America is better known the balance will probably be in favour of the western forms Prof Warming, however, includes among the eastern plants only those now living in Europe, the Asiatic-American species being classed as western on the ground that they must have entered Greenland from the west rather than from the east -a somewhat unsafe line of reasoning when we take into account former changes of climate and the local extinction of

many plants*
Prof Nathorst analyzes the list differently, and gives most suggestive tables and a map of the local distribution of the eastern and western plants in Greenland From these we find that the coast nearest to Iceland contains European forms a lone, the southern externity contains European forms and insports, while the part of the west European forms and insports, while the part of the west European forms in an insports, while the part of the west European forms in an insport, while the part of the west European forms and the part of the west European forms and the part of the west European forms and the part of the most of the form of Greenland is not entirely cut off by the Demmark Stratt, but extends eastward as far as Iceland

Prof. Warming considers that the nucleus of the present infor of Greenland represents part of the original fora, which was able to live through the Glacial epoch on the non-glaciated areas; but Prof. Nathors points out that the few non-glaciated mountain-tops must have been far too ligh for any phanerogams to cust on them, and all the lowlands were then covered with ice and snow. We must therefore consider that both eastern and western elements of the present flora of Greenland entered the country in post-glacial times. The tables of distribution

show at what points a large number of the plants entered,—they came from the nearest land, whether European or American. Whether in post-glacial times there was any complete land-connection between Greenhand and either North America or Iceland is very doubtful, but the straits collects in which was the sum of the strain of

Turning now to the British Islet, we know that a prolife temperate for a inhabited this country in pre-glacial times. We know also that this flora disappeared and was replaced by a thoroughly Arctic one, at least as far south as Norfolk, where its relics are found beneath the moraner. Then came a period when Britian north of the Thanes was covered with ree and snow, and only an in Greenland—rose above. When the ice iterated, the Artic phanerogams again spread over the country, for we find value plainary, S herbitac, S returlated, Retula mana, and I overleuring proximens in lacustrine deposits immediately above the boulder clay near Edinburgh; we have also a similar flora, with Sada polaria, S nyrvatites, and Jetula mona, in Stifflix, and even in Denonshire the state of the proper of the property of the country of the state of the property of the country of the closed with the present of the property of the country of the closed with the present of the property of the proposition of Greenland of Create India.

In Britain, however, we have now reached a later stage in the amelioration of the climate and re-settlement of the country, for the Arctic plants have either disappeared entirely or have retreated to our mountain-tops, and in their place on the lowlands we find a temperate flora now The British flora, like that of Greenland, varies according to the botanical character of the nearest land. though, as with Greenland, there is no reason, except the supposed impossibility of the migration of the animals and plants without a bridge, to imagine that during postglacial times there has been any direct connection with the Continent, save perhaps at the Straits of Dover The distribution of plants in Britain is so peculiar that I may be forgiven for pointing out to non-botanical readers that we have a southern flora opposite France, a Germanic flora on the east coast, a Lusitanian flora in the south-west, and on the extreme west there are two American plants unknown elscwhere in Luiope In the Britain of the present day I believe that we may study the re-peopling of a country over which everything has been exterminated and until we have fuller direct evidence of the stages of the process, we may safely accept Greenland and Britain as illustrating the way in which Nature works to fill gaps in the fauna and flora, whether these are caused by changes of climate, by volcanic agency, or the subinergence and reappearance of islands CLEMENT REID.

THE SUN'S CORONA

SOME little time ago Dr. Schaeberle, of the Lick Observatory, was good enough to send me the following letter.—

Allow me to call your special attention to a note of mine in the forthcoming number of the A. S.P. Publications, entitled "Some Physical Phenomens involved in the Mechanical Theory of the Cornes" I wish to say this, as far as the connection of this theory with the sur-spot period is concerned, there was not, at any time, any effort on my part to make an agreement with a transport of the part of the part of the properties of the and investible results of tracing certain observed phenomens to unexpected explanations. As you will see, the legical outcome

¹ Trans Lim Soc vol xxiii, pp 251-348 (1861), partly reprinted (with additions) in the "Maaual of the Natural History of Greenland,"

^{80 (1875)} Om Grønlands Vegetation Meddelelser om Grønland," Part 12 (1888) Ingler's botanisches Jahrbuch, 1831, p. 183

NO. 1135, VOL. 44]

of the whole matter is that, unconsciously, I have actually furnished important evidence in favour of your meteoric hypothesis.

Sincerely yours.

Sincerely yours,

I. M. Schaeberle.

Some time after the arrival of the latter I received the number of the Publications of the Astronomical Society of the Pacific which contained the arricle referred to the Pacific which contained the arricle referred to the state of the pacific pa

The point of newest interest, however, is that referred to in Dr Schaeberle's letter

Assuming eruptions most active in the sun-spot zones, and an initial velocity of 380 miles a second, he obtains the following results —

(1) All parts of a given unperturbed stream will be in a heliocentric latitude nearly equal to the latitude of the point of ejection

(2) For a constant ejective force the periodic time !
will be the same for all parts of the stream

(3) The chance of collision of a returning with an outgoing stream varies inversely as the square of the distance of the point of collision from the sun

(4) Near the sun, therefore, collisions must occur which tend to retard or stop the outgoing streams, resulting in a temporary increase in the heat of the combined colliding masses (causing a consequent increase in the brightness of the corona at such places, and at the same time rendering the coronal detail more conditived.) This heat will tend to be largely dissipated before such masses fall back into the sun, which they will then reach with comparatively small velocity and low temperature at the control of the comparatively small velocity and low temperature at the noise of impact perturbed returning streams could, of course, strike all parts of the sun's vurface. Unperturbed returning streams could, of course, strike all parts of the sun's vurface. Unperturbed returning streams will always fall within the limits of the sun-spot cones.

(3) So long as the incoming streams are very numerous, the outgoing ones will, in a great measure, be stopped, so that, after the internal f, there will be comparatively few returning streams a direct result of this state of things since there are now but few collisions, results in (1) as apparent diminution in the brightness of the corona, (2) more regular and sharply defined detail, and (3) in general a more uniformly illuminated solar surface might be expected, when there are but few or no returning streams expected, when there are but few or no returning streams of the surface of the surface

(6) If the ejective force is such as to make / about five years, a complex cycle of changes will take place in the time 21, and after the same manner as is observed in the sun-spot cycle. It is rather remarkable that the aphelion distance of the streams corresponding to this value of it is nearly the same as Jupiter's distance from the value of it is nearly the same as Jupiter's distance from the may have more to do with the regularity of the period than the assumed constant force of jection. The initial velocity required to just carry a particle from the sun to jupiter is but little less than a parabolic velocity. For an initial parabolic velocity, Suturn, alone considered, would, on the same lypothesis, cause a complete cycle of would, or the same lypothesis, cause a complete cycle of years, and Neptune in one hundred and those years, and Neptune in one hundred and the property of the comparatively insignificant planets inside of the

orbit of Jupiter would cause minor variations, corresponding to cycles, which, even for Mars, would be of less than two years' duration

(7) The chance of the earth passing through one of these outgoing streams, which have a mean latitude of 15°, 18 less than it is for an incoming perturbed stream

(8) A phenomenon similar to the observed zodiacal light would result from the projection of many such streams in space, and the observed extent of this light proves that the matter which causes this illumination extends to greater distances from the sun than the earth's distance.

It is evident from the foregoing that the complete statement which is to appear shortly will be looked forward to with interest

For myself, I am glad to think that the views I put forward in the concluding chapter of my "Chemistry of the Sin" "ull now be looked at from a new point of view. The Sil show what the "falls" which take the first place in my scheme, and the second in Dr. Schaeberle's, really are certainly I have seen no cause lately to alter the view I expressed in 1897, that the primary cause of solar disturnance is the desient of matter on the photosphery. Vis.

NOTES

ON Monday the Prince of Wales presented the Albert Medal of the Society of Arts to Mr W H Perkin, "for his discovery of the method of obtaining colouring matter from call tar, a discovery which led to the establishment of a new and import ant industry, and to the utilization of large quantities of a previously worthless material," and to via Frederick Abel, "in recognition of the manner in which he has promotel several important classes of the arts and manufacture of by the applica tion of clemical science, and e-pecially by his researches in the manufacture of non and steel, and so in advicedigment of the great services he has rendered to the viate in the provision of improved war material and as Chemist of the War Depart ment." The medal awarded to Mr. Perkin was for the year 1850, that to Sir Frederick Abel was for the years.

WE are glad to bear that in consequence of the deputation which waited upon Sir Michael Hicks Beach on June 5, the Board of Trade have registered the British Institute of Preventive Medicine as a limited liability company, with the omission of the word "himted."

It seems as if the introduction of large engineering views may soon produce a very marked effect upon the future of Egypt Mr Willcocks, one of the Inspectors of Irrigation, has communicated an interesting letter to the Times, from which we select the following remarks on the engineering importance of Dongola .- "The summer supply of the Nile is lamentably deficient for the existing cotton and sugar cane crops of Egypt, so that all extensions of these valuable crops are out of the question under existing conditions The Nile Valley in Nubia is emmently suited for storage of water, but up to the present all projects for storing the muddy flood waters of the Nile below the junctions of the Blue Nile and the Atbara have been condemned, as the construction of solid dams would have resulted in the silting up of the reservoirs themselves. This difficulty has disappeared now that it has been discovered that open dams can be constructed which will allow the muddy flood waters to flow through, and store the clear winter supply for use in summer The construction of these dams has been rendered possible by the great success of Stoney's patent roller-gates, which can be worked under heads of 70 feet of water on a scale sufficient to pass the full flood supply of the Nile. At any time now Egypt

can construct a reservoir in its own territory by building an open dam at the head of the Assouan Charact. If, however, Egryt were allowed to occupy the Nile Valley as far an Dongola, the reach of the rever above the Wally Halfa Catanet would provide the necessary testroolis, and the Phile immersion difficulty would be at an end. So far the summer supply needed for Egryt proper. If the Soudan stell' is to be developed, it will only be necessary to construct solid dams at the heads of the Hypon Falls and Fola Rapids, and thus secure the Victoria and Albert Nymara Lakes as magnificent reservoirs. These reservoirs would not only secure Egypt and the Soudan from drought, but would not only secure Egypt and the Soudan from drought, but would about. The With Opin dain, secure Egypt and the state of the stream, so that the viling up of the reservoir would be out of the ossetton, leaving alone their creat size."

WE very cordially congratulate Sir G B Airy (the ex-Astronomer Royal), on the completion of his nineticth year. A distinguished company assembled at the White House, Greenwich Park, on Saturday lest, in honour of the occasion.

PROF. ADALBERT KRUEGER, Director of the Observatory of Kiel, has been appointed Prof. Schonfeld's successor at Bonn

DR FELIX has been appointed professor in the University of Leipzig

THE Council of the Yorkshire College, Leeds, have appointed Mr V Perronet Sells, New College, Oxford, to be Extension Lecturer in Science

A PROJECT is in the six for the erection of an Observatory on Mont Blanc. M Janssun made an appeal list year for support in this undertaking, and on Monday at the Academy of Sciences he announced that his appeal had been heard. He has obtained the support of M Bischoffishim, Prince Roland Bonaparte, Baron Alfred de Rothschild, member of the Academy of Fine Arts, and M. Effel

THE annual meeting of the Institution of Mechanical Engineers was opened on Tuesday at Liverpool

SANITARY science has, during the last month, lost one of its pioneers, in the person of Dr John Sutherland, whose record of work in the domain of santtation since 1848 has been of a marvellous character. In 1848 he entered the public service under the first Board of Health, and continued to be employed under the Home and Foreign Offices till the year 1855 During this time he conducted several special inquiries-notably one into the cholera epidemic of 1848-49, which is even now frequently referred to 112 was the head of a commission sent to various foreign countries to inquire into the law and practice of burial. He represented the Foreign Office at the International Conference, held at Pans in 1851-52, for regulating quarantine law In 1855 he was engaged at the Home Office in bringing into operation the Act for abolishing intramural interments, a task which he had undertaken at the request of Mr Walpole He was also doing duty in the reorganized General Board of Health, under the presidency of Sir Benjamin Hall, when, at the request of Lord Palmerston and Lord Panmure, he became the head of the commission sent out to inquire into the sanitary condition of our troops engaged in the Crimean War He found in Miss Florence Nightingale a devoted coadjutor in regard to the hospitals. Dr Sutherland took an active part in the preparation of the report of the Royal Commission (of which he was a member) on the sanitary state of the Army, dated 1858, and also of the report of the Royal Commission on the sanitary state of the Army in India, dated May 19, 1863. Both of these were of vast importance to the welfare of our soldiers, and most of the recommendations con-

tained therein have been carried out. One of these was the appointment of the Barrack and Hospital Improvement Commission, with Mr Sidney Herbert, M P, as President, and Cantain (now Sir Douglas) Galton, Dr. Burrell, of the Army Medical Department, and Dr. Sutherland as members. By this committee every barrack and hospital in the United Kingdom was visited, and its sanitary condition reported upon Defects were brought to light and remedied, and the health of the troops consequently much improved Subsequently Dr. Sutherland and Captain Galton visited and made similar reports on the Mediterranean Stations, which at that time included the Ionian Islands All these reports were presented to Parliament, and a reference to them will show the vastness of the work undertaken In 1862 the Batrack and Hospital Improvement Commission was reconstituted, and all sanitary reports were submitted to the committee and reviewed by them, and suggestions for improving Indian stations prepared. This continued up to the time of Dr. Sutherland's retirement, on June 30, 1888 In 1865 he again visited Gibraltar and Malta, and made an independent and special report on the outbreak of epidemic cholera at those places In 1866, Dr Sutherland in communition with Mr R. S. Ellis, of the Indian Civil Service, Dr Joshua Paynter, of the Army Medical Department, and Major (now Lieutenant-General, (B) Fwart, R.E, visited Algeria, and reported on the causes of reduced mortality in the French army serving in that country, with a view to seeing what of the conditions in force there would be applicable to Her Majesty's troops serving in India and other warm climates. The value of the recommendations made by him and his colleagues will be better understood by a comparison between the vital statistics of the army prior to the time of the Crimcan War and those of the present date than in any other way

MR WILLOUGHBY SMITH, who had played an important part in connection with submarine telegraphy, died on July 17. He was born in 1828, and in 1848 entered the service of the Gutta-Percha Company, and superintended the manufacture and laying of the first submarine cable. The Times gives the following account of his subsequent career. In 1864 the Gutta Percha Company became merged in the Telegraph Construction and Maintenance Company, and Mr Smith remained with the company as chief electrician and manager of the gutta percha works until his retirement through failing health in 1887. In 1866 he was electrician-in-charge, being on board the Grea Eastern during the laving of the first successful Atlantic cable. and the recovery and completion of the cable that had been lost the year before Mr Smith was President of the Institution of Electrical Engineers in 1887, before which Society, as well as before the Royal Institution, he read many interesting and valuable papers Amongst these was one on his discovery of the effect of light on the electrical quality of selenium, and another on his researches in volta and magneto electric induction.

Mr DANIEL MACKINIONI, F.G.S., died at Birkenhead las week at an advanced age. He was the author of a work on "The Scenery and Geology of England and Wales," and his researches on certain traces of the glanal epoch were well known to geologists. In recognition of his services to geologists seence, the Geological Society presented him in 1886 with a great from the Lyell Fund.

MR EDWARD STANFORD has published a pamphlet on "The Spread of Indicens; its Supposed Relations to Atmospheric Conditions," by the Hon R. Russell. The following are some of the author's conclusions as to the conditions which give rise to influenza, and permit it to be spread. Influenza is a disease caseed by exceedingly minute merches, arming from extensive areas of must hor produce in and in Central Asia, China, or Sibarian. The minuteness of the microbes or their spores a showbuy their

easy transmissibility, and the large number of persons capable of being infected by a single case in a large room, most persons probably requiring many virulent organisms to be inhaled in a short time before the resistant power of the blood is overcome This microbe, like that of cholera, multiplies with great rapidity, and probably soon produces sufficient poison to terminate its career in the body, but not before multitudes of spores or microbes have been given off by the breath. Given the original conditions of rainfall, soil, and high temperature, the certain result is the development of inconceiva ble multitudes of microbes and spores, one species of these is capable of planting itself and living in the tissue and blood of man, of which the temperature is probably near that to which it has been accustomed under the summer sun in wet and drying ground The somewhat rare and occasional visitations of influenza may he due to at least two or three causes-first, the occurrence of nnusual rainfall and favourable summers , second, the prevalence of air-currents from the drying area towards inhabited places, third, adequate communication between these infected places and the towns of Russia, whence progress is rapid towards Western Europe The wind has no influence that can be verified in the transportation of influenza. As for the means of prevention, Mr Russell thinks that measures of disinfection and isolation of the earliest eases, and rules at ports and landing places similar to those employed against cholera, would probably prove of the greatest service Inland, every locality should isolate and disinfect its first cases

PROF. LANGLEY, the Director of the Smithsonan Institution, in own in this country J n-year of his recont researche, referred to in our last number, we learn that Mr. Maxim is boulding at "flying machane," with which a series of experiments is contemplated, it is now being constructed at Crayford, and is nearly ready for launching. It will be propelled by a light screw making 350 serviations a minute. The motive power (it is reported) is upplied by a perroleum condensing engine weighing eighteen hundred pounds, and capable of rasing a forty thousand pound load. The real suspending power will lie in an enormous keit measuring it to feet long and 40 feet wide

THE following passage occurs in the Report of the Medical Officer of Health of the parish of St George, Hanover Square, for the five weeks ending July 4, 1891 -"I have calculated the death-rate of the parish for the past month on the eensus population of 1881, and not on that of 1891, for the following reasons .- The census population of the parish in 1871 was \$9,758, and that in 1881 was \$9,573, I have no reason to believe that there was any serious inaccuracy in either of these enumerations, so that the population of the parish was practically stationary during the ten years from 1871 to 1881 The enumerated population in 1891 was only 78,362, showing as apparent decrease of 11,211 (or one-eighth of the population) since 1881 I know of no reason whatever for any such decrease, and do not believe it has taken place. The census was taken of the persons sleeping in the parish on the night of Sunday, April 5, a day which had two serious disadvantages, the first being that it was a Sunday, a day on which many people in this parish are out of town, and the second that it was the Sunday after Easter, and that large numbers of people had not returned to town from their Easter holidays. I therefore consider that the enumeration of the population of the parish this year is of no value for statistical purposes, and in estimating the birth-rates and death-rates, shall continue to use the census population of 1881, until a fresh and more correct enumeration shall have been made, which will, I hope, be in 1896" This is rather serious. What have our eensus authorities to say on the matter?

NO. 1135, VOL. 44]

An earthquake was experienced at Evansville, Indiana, on the 26th inst The shock was so great as to create a panic in several places of worship. Considerable damage was done to property. The direction of the oscillations was from north to south

THE weather prospects in the North-West Provinces seem to be improving Beneficial rains have commenced to fall, and a famine is therefore less probable than it was The distress among the ryots is, however, great, and the Government of India has voted a grant of \$\int 10.000 for their relief The follow ing telegram was read by Sir J. Gorst, on Tuesday night, in the House of Commons -" There is an improvement in agricultural prospects and development of monsoon season. There has been good general rainfall throughout the country, except in part of Madras, the Carnatic, and Upper Burmah, in consequence of which there is no present cause of anxiety in Northern India Strong monsoon blowing West Coast More rain imminent in Punjab and Rajpootana, where fodder famine has been arrested by rain Crop operations in Northern India generally progressing satisfactorily, and there is no present cause for anxiety in North-West Provinces and Oude "

Tits Technical Education Committee of the Kent County Council has placed £3000 at the disposal of the South-Eastern Counties Association for the Extension of University Teaching, for courses of lectures suited to agricultural and rural populations in small towns and villages throughout the country.

Tits Accademia delle Scenze dell'Issuituo di Bologno offens a godi uncidal of cool ine value (about 4,0), the Adim Prae, "to the author of a memor which, based on certain data of chematry, or physic, or applied mechanic, shall indicate new and really practical systems or new apparatus for prevention or extinction of fees." The memors may be manucerpin in Italian, and the statement of the statem

I is most recent addition to Prof Flower's excellent sense of specimens illustrative of sological structure placed in the eartance-hall of the Natural History Museum is a test of nine-end obsections prepared by Mr. O. Redwewd to I blustrate the visions on the deep plantar tendons of the bard's foot. With the help of these preparations, the student will have little diffi-culty in anderstanding the mysteries of the fleer foreign ballions and the fleers preforms displacement, page which two municles, as has been shown by Sundeval, Garrod, and Forbes, so much depends in the classification of birds.

It would seem that the present interest in agracultural instruction comes none too soon. The Aquicultural Gasatte of New South Wales gives an account of a new industry—the export of butter to this country, and adds, that the Minister of Mines and Agraculture has approved of the establishment of a travelling dairy to impair instruction to the settlers in relation

THE same number contains articles on the grasses and weeds of the colony, and notes on economic plasts and weeds, besides information of what some people consider as of a more "practical" character, touching profitable cows and pigs

THE uthration of waste products is the order of the day. An interesting article on this subject, in relation to breweries, in the Breweri Guardian, calls attention to the utilisation of the carbonic and gas produced in the fermentation of sugar "On an average, English beer may be considered to contain 5 per cent, of alcohol, and as, in the fermentation of sugar, the

weight of carbonic acid produced is almost the same as that of alcohol (the exact proportions being 48'9 of carbonic acid to 51'1 of alcohol), there must have been 500,000,000 pounds of carbonic acid produced in our breweries The specific gravity of carbonic acid is 0.1524, and therefore a simple calculation shows that the above weight is equal to 25,000,000,000 gallons -a volume it is almost impossible to realize, such a volume would require a space one mile square and forty yards high to contain it. It is now proposed to utilize the greater portion of this large quantity of carbonic acid. The process by which this is to be done has been tried for some little time past in St James's Gate (Guinness's) Brewery, Dublin , and Sir Charles A Cameron has reported very favourably on it. The following are the conclusions at which he arrives after a most careful examination of the process -(t) An immense quantity of carbonic acid is produced in breweries, and is at present wasted, (2) a large proportion of this gas could be condensed to liquid at a cost not exceeding he per pound, but probably less than ld per pound, (3) the process of liquefying the gas is successfully carried on at Guinness's Brewery, Dublin , (4) the liquefied gas prepared at Guinness's Brewery is perfectly free from any peculiarity of flavour or odour, (5) the carbonic acid produced at soda-water works costs about 4d per pound, (6) it is safer, and in every way more desirable, to use in beverages carbonic acid derived from a food substance, such as grain, than from mineral sources: (7) the uses of hourd carbonic acid are numerous. important, and increasing "

AMONG the plants shown at the meeting of the Royal Botanic Society on Saturday last was a museum specimen of one which had lately died in the Gardens-a victim to the late severe winter This was one of several specimens of the East Indian or white mangrove. Avicennia nivea, sent to the Gardens by the late Duke of Buckingham when Governor of Madras For some years past these plants had flourished amazingly, thanks to the near approximation to their natural condition attained by keeping them in a very wet state and watering only with seawater Under these circumstances they threw up from the roots a number of offsets, or upright adventitious roots, of from 10 inches to 12 inches high, and half an inch thick In a space of 2 feet square as many as eighty appeared, looking like so many rakes standing up out of the water, and keeping as near as possible the same height above the surface. The only explanation, so far, has been that offered by the Secretary, Mr. Sowerby. In its native state the trees form a fringe along the sea-shore and estuaries of great tropical rivers, lining the banks with a dense and impenetrable mass of vegetation, pushing itself further and further into the river or sea, and leaving behind the dry land it has reclaimed. In such a position these curious rootlets must be an immense advantage to the plant, enabling it to retain all the debris washed to the sides, and at the same time preventing the soil between the roots from being carried away by floods, &c The plants of this species now growing in the Gardens are the only ones alive in this country,

A MOST interesting report of a journey taken along the frontier of the British Protectorate of Nyassaland by Mr J. Buchanan, C M.G., Acting Consul at Nyassa, appears in the Kew Bulletin for July.

FROM the Meteorological Observations at Sydney for January 1891, just received, we learn that the temperature was 2° higher, the humidity 2 4 less, and the rainfall 0°87 inch greater than that of the same month on an average of the preceding thirty two years.

THE Indian Government has just issued a "Contents and Index of the first twenty volumes of the Records of the Goological Survey of India, 1868-87" Considering the important work done by this Survey, the index will be of great value to geologists. It consists of 188 pages

NO. 1135. VOL. 44]

THE pamphlet entitled "A Summary of the Darwinian Theory," which was noticed in a recent issue (1914, 6, p. 247), has been printed for private distribution. The author, Mr. Pascoc, will supply a copy to any person interested in the subject on application to him at 1 Burlington Road, W

A new and cheaper edition of the translation of vol. i, of Wesmanns' "Essays upon Heredity and Kindred Bologora Problems" is announced for immediate publication by the Clarendon Peres; and we understand that vol. u is in the price, and will consist of four additional essays, and a preface by Prof. Westmann.

Petermann's Mitteilungen for July contains an article on Zante, with an original map, based on the English Admiralty chart, by Prof Partsch

An official notice has been issued concerning the chariable foundation instituted by the Sitters Froetich at Venna for subsidiating persons distinguished in science, art, or literature. Persisons and donations are to be granted to duly approved applicants: Applications should be addiessed to the Trustees (das Caratonium), and transmitted to the President's office of the Common Connell of the City of Vienna (an dar Prandalbureau des Wiener Gennelentwishe Nues Kathasu) before August 13, 1891, through the I and K. Austro-Hungarian Embasy in London, 18 Befgaree Square, SW, where particulars of the terms and conditions of the foundation deeds, &u., can be obtained.

FURTHER details concerning the new volatile compound, iron carbonyl, Fe(CO), are published by Messrs Mond and Quincke in the current number of the Berschie. It appears that as early ns November last year they succeeded in volatilizing small quantities of iron in a stream of carbon monoxide, and recovering it again in the form of a metallic mirror by passing the gaseous product thro heated tube. The best results are given when the iron is obtained by reduction of ferrous oxalate in a stream of hydrogen at as low a temperature as possible, very little exceeding 400° C , and allowing to cool in the stream of hydrogen to 80°. When carbon monoxide is led over the finely divided iron thus obtained, the issuing vapours are found to colour a Bunsen burner pale yellow, and if they are passed through a glass tube heated to a temperature between 200 and 350', a mirror of metallic iron is deposited. If the tube is heated to a temperature superior to 350°, instead of a nurror a black flocculent deposit is obtained. containing carbon in addition to iron. The metallic mirror dissolves readily in dilute acids, and the solutions give all the reactions of iron A quantilative analysis was made of one such mirror, and yielded almost theoretical numbers for pure iron. The black flocculent deposit was found in two cases to contain 79 30 and 52 78 per cent of carbon respectively. The reaction, however, proceeds only very slowly To give some idea of this, Mesers Mond and Quincke state that after six weeks continued treatment of twelve grams of iron with carbon monoxide only about two grams had been volatilized. As the action becomes very slight indeed after treatment for some hours, the operation was interrupted at the end of every five or six hours, and the iron reheated to 400° in a stream of hydrogen, after which the reaction proceeded again as at first. It is calculated that the average amount volatilized was about two cubic centimetres per litre of carbon monoxide. This great dilution has of course rendered it very difficult to ascertain the composition and properties of the substance. Its composition has, however, been determined by absorbing the vapous obtained during eight to sixteen hours in mineral oil of boiling point 250°-300°, which after numerous experiments has been found to be the best solvent for it, and heating the solution thus obtained to 180°, when it becomes black owing to the separation of metallic iron, and carbon monoxide is evolved. Determinations of the amount of separated iron and

the volume of carbon monoxide obtained in five such experiments gave for the proportion of molecules of CO to one atom of iron the numbers 4 14, 4 03, 4 15, 4 26, and 4 04 respectively Hence there can be very little doubt that the compound is represented by the formula Fe(CO)4, analogous to the nickel compound obtained last year, Ni(CO)4. As regards the relation of the compound to the processes of iron and cementation steel manufacture, the authors are of opinion that, although they have been unable to prepare it at temperatures between 150° and 750°, still it is quite possible that it may be momentarily formed at such temperatures. but soon Immediately dissociated

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (Macacus cynomolgus) from India, presented by Mr G Stevenson Macfarlane, a White fronted Capuchin (Cebus albifions) from South America. presented by the Earl of Carnaryon, a Silver-backed Fox (Canis chama 8) from South Africa, presented by Mr Max Michaelis, a Ring-tailed Coats (Nasua rufa) from South America, presented by Mr. J. Smalman Smith, two Rough Foxes (Canss rudss) from British Guiana, presented by Mr. G H Hawtayne, C M Z S , two Pennsylvanian Buzzards (Buteo benneylvaniens) from North America, presented by Sir Walter Hely Hutchinson; a Barn Owl (Strix flammea), British, pre sented by Mr. E Hart, F Z S., a Tigrine Cat (Felis tigrina), two Spotted Cavies (Calogenys paca), a White-hpped Peccary (Dicotyle labiatus), a Red and Yellow Macaw (Ara chlor optera), a Blue and Yellow Macaw (Ara grarauna), two Orange-winged Aniazons (Chrysotic amazonica), two West Indian Rails (Acamides cayennensis), a Martinique Gallinule (Ionorms martinicus) from South America, a Golden Agoutt (Dasyprocta agutt), three Crested Curassow (Crav alector) from Guiana, a Hawkheaded Parrot (Direptyus accipitrius), a Common Trumpeter (Prophia crepitant) from Demerara, deposited, an Azara's Agoutt (Dasyprocta azara) from South Brazil, purchased

OUR ASTRONOMICAL COLUMN.

OBSERVATIONS OF SUN-SPOIS AND FACULE, -- Comptex rendul for July 13 contains the results of observation of sui-spots and faculte, made by M Marchand, at Lyons Observation, during the first six months of this year. The following table expresses, in millionths of the sun's visible hemsphere, the surface overered by spots and facult, during this period

1891		Surface covered	Surface cove
January		by spots	by faculæ
rebruary		385	12 5
reoruary		503	20 7
March		265	15 9
April		726	25'4
May		670	22't
June		968	29 7
1	Total	2517	126.2

These figures demonstrate the increase in solar activity which must have been noted by all observers
The total spotted area must have been noted by an observers the total spotted area of 3517 millionals is made up by 65 groups Duning the whole of 1890 the spotted area given by 43 groups was only 3760 millionths. Since the end of March not a single day has passed without a spot being seen on the sun. With regard to distribute the state of the sun with regard to distribute the state of the sun with the state of the sun with regard to distribute the sun with the sun w tion, 40 groups have appeared in the northern hemisphere as against 25 in the south. These occurred most frequently between the latitudes ± 20° and ± 30° At the same time 22 groups the latitudes ± 20° and ± 30° At the same time 22 groups have had latitudes between 10° and 20° (with four groups below

is a list action between to and 20 (with noir groups below 15%), thus indicating an approach to the equator.

The measures of faculte give similar results. The two zones from 20° to 30° are the richest, and those from 0° to 10° the poorest. The total numbers are sensibly the same in both poorest. The total numbers are sensitily the same in boun-hemispheres. There is, however, a slight supersority in relation number in the northern hemisphere, but less marked than during 1890. The total surface covered by facults in 1890 was 1937 millionths of the sun's visible disk, so that the figures now given indicate a considerable augmentation. It is also worthy of note that the results obtained for apots and faculæ show a certain parallelism, secondary minima in March and in May occurring each case

STARS HAVING PECULIAR SPECIES. -- In a communication to Astronomische Nuchrichten, No 3049, Prof. Pickering notes that a Group II star situated in Sagitarius (R. A. 19h 51 8m, that a Group II star situated in Sagittarius (R.A. 19h 518 m., Decl. - 42°7, 1900), having exhibited bright hydrogen lines in its photographic spectrum, was suspected of the variability of which this appearance is a characteristic. Measures of photo-graphs of the star taken on different dates proved that the apposition was a correct one, and indicated a variation between the magnitudes 9 1 and 13 1.

the magnitudes 9 1 and 13 1.

The photographic spectrum of the star S.D. - 12 1172 (R.A. 5h. 22 9m., Decl. - 12 46), mag 9 2, appears to be the same as that of a planetary nebula as regards the positions of lines, but it differs in the interesting fact that the H_B hydrogen line (F) is unusually strong in comparison with the nebula line at \$ 500.

is unusually strong in comparison with the nebula line at \$ 500. I was more stars having specia assinly consisting of bright lines there stars in Cypnus discovered West Carlotte and Cypnus discovered West Carlotte and Cypnus discovered West Carlotte and Carlotte and Carlotte and Fan Stars in the lossinon R A 13h 36 jm , Decl = 66° 55° (1900) The number of stars of the Wolf Rayet type is thus brought up to thirty-

THE INSTITUTION OF NAVAL ARCHITECTS

THE first London summer meeting of the Institution of Naval Architects was held on Thursday, Friday, and Saturday of last week During the thirty-one years that the Institution has existed, it has only held five summer meetings. The first of these was in Glasgow, and was highly successful, but it was not followed by another summer meeting until the year 1886, when the attractions of the Liverpool Exhibition were sufficient to cause the Council to arrange a second meeting for that year in the second city of the kingdoin. The Newcastle and Glasgow Exhibitions followed in the two succeeding years, and the members accordingly were summoned to the banks of the Tyne and Clyde All these meetings were successful in every respect, not only in adding to the membership of the Institution, but in the valuable papers contributed to the Transactions, and the interest of the various excursions. In the I ransactions, and the interest of the various excursions. In spite of this, no summer meeting was held either in 1889 or 1890, in which years there were but the single three days meeting in the spring. That has been conclusively proved not to be sufficient time for the conduct of the business of the not to be sufficient time for the conduct of the nusiness or true year, and at the last spring meeting it was amounced that in future two meetings would be held every year—the first to be the usual spring meeting, which always takes place in London, and the second to be held in the summer, either in London or clewhere. The success of the meeting just held strongly supports the widom of this decision

There was naturally not so long a list of papers on the pro-gramme as there is at the spring meeting, for allowance had to be made for the excursions. With the latter we are compelled to deal very briefly on account of pre-sure on our space, and we will therefore say a few words upon them at once, before pro-ceeding to notice the papers. On the first day, Thur-day, the 23rd inst, the afternoon was devoted to the Royal Naval 230 mis, the attention was devoted to the Royal Naval Ex-hibition, and in the evening there was a dinner, at which Lord Brassey presided, the absence of the President, Lord Ravens-worth, being eaused by a domestic sorrow. On the Friday afternoon the excursion was to the shippard of Samuela Brother, atternoon the excursion was to the shippart of Samuela around, at Poplar, and to the Thames Ironworks at Blackwall. The P and O Company also gave a luncheon, in the Albert Docks, on board the Carthage At Samuelas' the two second-class cruisers H.M. SS. Sappho and Scylla are in course of construction, and give quite a welcome air of busile and activity to the Poplar yard, not long since a scene of what many thought to be permanent stagnation These ships are 3400 tons each, and be permanent signation These ships are 3400 ions each, and opool indicated horse-power. A large amount of armour-plate bending and machinery is now going on in this yard, and the machine tools were examined with much interest by many of those members to whom such work was new. At the Thames Ironworks there are also two ships in progress for the Royal Navy. These are the cruisers Grafton and Theseus. The latter name brings up stirring memories of another noble ship built in years past at Blackwall. The new steel Theseus is,

however, a very different craft from Nelson's old flag-ship. She and her satter-vessel the Grejron are each of 7350 tons displacement, and have engines which will develop 12,000 indicated the state of the state of

those who winder to return to London by water were enabled to do to The three great engineering firms, Penns, Maudilays, and Humphrys, also threw open their works to the inspection of members during the meeting with the proceedings at the two morning sittings of Thursday and Friday, during which the two morning sittings of Thursday and Friday, during which six papers were read and discussed, of which the following is a -Ships of war, by Sir Nathaniel Barnaby, K C B.; on the alterations in the types and proportions of mercantile vessels, together with recent improvements in their construction and depth of loading, as affecting their safety at sea, by B. Martell, Chief Surveyor of Lloyd's Register of Shipping, centre and wing ballast tank suctions in double-bottom vessels, bentre and wing curisist tank sactions in double-outloin vessels, by G. R Brace; some notes on the history, progress, and recent practice in manne engineering, by A. J. Durston, Engineerin-Chief to the Royal Navy, progress in engineering in the mercantile marine, by A. F. Seaton, on the weak points of steamers carrying oil in bulk, and the type which expertence On the meeting being opened, Lord Ravensworth, the Press-On the meeting being opened, Lord Raviensworth, the Press oftent of the Institution, who occupied the chair, proceeded to desire the control of the control of the control of the real at the last meeting. The gold media is not given to members of Council, so that some of the papers send at the Brandy's paper brought forward some of the most values fea-tures in the history of war-ship design during the thirty-one sears which have elepted since the Insuitation was founded. An interesting fact noticed was that our earliest armour-clad, the Warrior, and our latest, the Kamillies, were of exactly the same regirence of the Warrary between the content of the warrary between the warrary betwee thick , her coal endurance is 5000 knots as against the Warrior 1210 knots, her weight of broadside is 5500 pounds, as against the Warrior's 1918 pounds. These figures well illustrate the progress made in the science of war ship construction, and the advance also extends to less desirable elements. for the cost of awahea axis extends to leas desirable elements, for the cost of the hull and enquires alone of the english first-class battle-ships and apacee, whilst the liVurror cost £35,000. It may be of interest to our readers it we add that the cost of a first-cash battle ship at the legimning of the century was about £70,000. The addi-tion of machinery and other improvements brought the cost of the 121 gun screw three-deckers, which followed the Crimean War, up to close upon a quarter of a million The armour alone of the Ramilius has cost exactly the same amount as the Natural of the Kannilitte has cost exactly the same amount as the Natural History Museum at South Kensington Bearing these facts in mind, it will be interesting to remember that Lord Brassey has laid down, in the programme of shipbailding he would propose for the next five years, the number of first class battle-ships as ten; in addition to an amounted coast defence vessels, six armoured rams, forty crusers of the first class, thirty look-out ships, and fifty torpedo gun vessels. class, thirty look-out shaps, and fifty torpedo gun veseds. Nothing is said about the smaller torpedo dar, albough a first-class (toppedo bast co-ts nearly as much as a forty-gan first-class (toppedo bast co-ts nearly as much as a forty-gan are, bowever, not so moderate as Lord Brassey; and Admiral Sor John Hay said, during the discussion on Sir Nathanide to the state of the said of the state of the said of the involved in the carrying out of such a programme as this, they are not so great, compared to the corresponding expenditure foreign Powers in terms of the value of the commerce which the ships produced would have to protect. Admiral Six Edward Free-mantle, Lord Brassey, Sir John Hay, Mr. Wigham Richardson, the Director of Naval Constitution (Mr. W. H. White), Sir

a long and interesting description NO. 1135, VOL. 44

Edward Reed, and others, spoke in the discussion, which was of

Mr. Martell's usper described the progress of that part of meal architectural design which bears more particularly on the construction of cargo steamers. The author traced the process of evolution by which the early teamers, naturally modelled after the sating ships which they succeeded, gave place to later of the contraction of the production seemed warranties. Even the finding boats to the contraction of th

Mr Brace's paper dealt exclusively with the detail of ship construction set forth in the title As it took exception to Lloyd's rule. Mr. Martell naturally criticized it with considerable severity.

There is added to the page to the color to the color of t

* Unst of power = 1 indicated herse power.

NATURE

horse-power per ton of machinery had also reached 7.5 The eapacity of boilers per indicated horse-power was 2.17 cubic feet, the heating surface per indicated horse-power 2.6 square tect, the heating surrace per indicated noise-power 2 square feet, the horse power per square foot of grate 9:41 units, and the coal consumption per indicated horse power per hour 2 811 pounds. Looking back over the twenty-two years that have clapsed since the Hercules was tried, and remembering the stringent and limiting conditions under which war ship engines were then designed, one cannot but be struck by the remarkably successful results attained with the engines of the Hercules No succession results attained with the engines of the December 100 doubt this was due to the extraordinary pains taken in the design and manufacture of the engines of Her Majesty ships inthose days. The introduction of more complex machine tools in the workshop has enabled much of this minute care and finish to be dispensed with, and the advances in metallurgical science have put has yet exceeded, or, we believe, ever will exceed, the beauty and accuracy of the noble examples of the mechanic's art constructed at the Greenwich shops under the direction of that prince of engineers, the late John Penn At the same time we gladly acknowledge that the general average of all engines has im-mensely advanced, and is still advancing, both in design, material, and finish. The whole of these three qualities are due to a wider and fifth I he whose of these three quanties are the to a whose spread of that knowledge of scientific principles upon which the mechanical arts are founded. The manual skill of the handicraftsmnn has not increased, on the contrary, it has deteriorated as inechanical contrivances have superseded the old hand opera-

From this digression we will return to the table in Mr Durston's paper, and take one more example This shall be the Purson's paper, and take one more example Internal ne the Repail Oal, a visiter of the Kamillier before mentioned, and one of the eight monster line-of hattle ships now in progress—the bugget war ships ever yet designed Laird Brothers, of Birkenhead, are the contractors for the Repail Oak She has the vertical triple compound engines and ordinary return tube boilers of the present day. The indicated horse power is put down at 13,000, but will doubless be much more, the steam pressure being 155 pounds per square meh, and the paton aprecé of 18 feet to the properties of the propert are made, a matter of conjecture, but there is every reason to anticipate it will approximate to that of the best performances recorded for Her Majesty's ships-namely, about 2 pounds of fuel recorded for Her Maşeniy's shaps—namely, about 2 pounds of feel per hour per mideate thore power developed with natural draught In taking this figure, however, we are somewhat unfair to be earlier 600% ergente on forced draught, a condition under which the fuel consumption would be much higher. What may be the fuel consumption of Her Majesty's ships under forced draught we have no means of knowing. It should be remembered that, to the Royal Navy, the steam generated in the main holters is used for the many auxiliary engines also, but the indicated horse-power of the main engines only is taken. This manifestly puts the engines of Her. Majesty's ships at a considerable disadvantage in the matter of fuel economy when comparison is made with mercantile engines If we had to summarize the lessons taught mercantile engines If we nad to summarize the lessons taught by Mr. Durston's tables in few words, we should say the steppingby Mr. Durston statues in tew words, we should say the stepping-stones to advance in marine engineering have been multi-tube builers, compound surface condensing engines, and forced draught The latter is still in that state of popular disfavour which seems to be the natural condition of all innovations on established practice, but it will yet make its mark, and lead engine-designers to higher results, whilst it will drive them to more perfect work

to higher results, whilst it will drive them to more perfect work.

Mr Seaton is well known as one of our best marine engineers, and is, moreover, a whiled writer, with a special talent for communicating his ideas through the medium of the pen That is well proved by he contributions both in the shape of memoirs to technical Societies and also by his well-known work memoirs to technical Societies and also by his well-known work on the marine engine. Unfortunately for the literary side of his on the marine engine, the continuated properties of the contract of the contra

¹ The indicated horse power of the Santegnes, the big Italian war-vessel, is stumated to be a zooo. This is the lurgest power yet designed for any ship. There are four sets of engines, two for each propeller.

NO. 1135, VOL. 44]

anxious to fulfil his promse to contribute to the proceedings, and has evidently done the best time would allow. His paper is a good illustration that "there is always plenty of room at the top," good illustration that "there is always plenty of room at the top," in the engineering, as in all other professions; but it does not call for any extended notice here. The same thing may be said of Mr. Eldridge's paper, which dealt mustuley with technical details It is, however, a distinctly valuable contribution to the Tensacions of the Institution, and may be studied with advantage by all navul architects who may have to design steamers for covering periodium in bulk—results that are fast growing in the contribution of the covering that the contribution is the contribution of the covering periodium in bulk—results that are data growing in importance and numbers

The meeting terminated with the usual votes of thanks.

SEVENTH INTERNATIONAL CONGRESS OF HYGIENE AND DEMOGRAPHY

THE arrangements for this Congress—which will be opened by the Preadent, HRH the Prince of Wales, on Monday, August 10, at the first general meeting at St Jaine's Hall, when short addresses will be given by some eminent foreign

hygienists—are now in a very complete state

We may mention that the previous Congresses were held in
Brussels, Paris, Turin, Geneva, The Hague, and Vienna, at the last of which it was resolved, on the invitation of the Sanitary Institute and the Society of Medical Officers of Health, that the next Congress of the series should be held in London in the

present year

Besides the Permanent International Committee, to which a number of additional members have been attached for the pur pose of this Congress, the executive consists of an Organizing Committee, with Sir Douglas Galton as Chairman, a Reception Committee, with Sir Spencer Wells as Chairman, and Mr Malcolm Morris as Honorary Secretary, and a Finance Com-mittee, with Surgeon-General Cornish as Chairman, and Dr Moline as Secretary

There is also a numerous Indian Committee, with Mr. 5. Digby as Honorary Secretary, and an Eduing Committee.

Prof. Corfield, whose address at The mittee, with Mr S. Digby as Honorary Secretary, and an Edung Committee. Prof Corficld, whose address at The Haque Congress in 1884 was the origin of the present one (see NATURE, vol. xlim p 511) is the Honorary Foreign Secretary of the Congress, and 1r G V Poore the Honorary Secretary General

The Congress is divided into nine Sections under Hygiene, and one under Demography, which includes Industrial Hygiene, and deals with the life conditions of communities from statistical points of view. The Hygiene, Sections will meet in Burlington House and in the University of London They arc as follows -

(1) Preventive Medicine K C.S I. President, Sir Joseph Favrer,

K.C.S.I. (2) Bacternology Precedent, Ser Joseph Lister, Barr. (3) Bacternology Precedent, Ser Joseph Lister, Barr. (4) The Relations of the Desire of Chimala to those of March 1997 and the Chimala of the Chimala of the London School Board (5) Chemistry and Physics, in Relation to Hygiene Pre-

sident, Sir Henry Roscoe, M P

(6) Architecture in Relation to Hygiene. President, Sir Arthur W. Blomfield

(7) Engineering in Relation to Hygiene President, Sir John Coode, K C M G (8) Naval and Military Hygiene President, Lord Wantage,

(8) Naval and Military Hygiene President, Lord Walliage, K.C.B., V.C. (9) State Hygiene President, Lord Basing. The Demographic Division will meet in the theatre of the Royal School of Mines in Jermyn Street, under the presidency of Mr. Francis Galton

A large number of papers are promi ed, some on subjects selected by the officers of the Sections, and some on other subselected by the officers of the 'sections, and some on other sub-jects; indeed, there is such a profusion of papers that it seems very doubtful whether it will be possible to deal with them all during the four days available for the purpose, especially as we are liformed that most if not all of the Sections will only sit

are informed that most in man in the decomposition of the from 10 a m. to 2 p m. In the from 10 a m. to 2 p m. In A was number of public hocker in this country. Delegates have been appointed by the Gorenstein of all the European and several other countries, and all the years foreign Universities, cities, public inclusions, and all of years foreign Universities, cities, public inclusions, and all controllers. There are also a mamber of delegates from India and the colonies.

An Honorary Foreign Council, including the names of most of the best known foreign hygienists, has been appointed, and also an Honorary Council of the British Empire, with representatives from India and the colonies.

A Bacteriological Museum and Laboratory will be a special feature in connection with the work of the second Section; and an exhibition of drawings of sanitary construction, in connection with the work of the sixth Section, will be arranged in the Library of the University of London under the direction of Mr. Thomas W. Cutler.

As is usual in gatherings of this kind, a considerable number As is usual in gatherings of this kind, a considerable number of entertainments, excursions, &c., have been arranged for, including an entertainment at the Guidhall, conversationes at the Royal Colleges of Physicians and of Surgeons, and a dinner and file at the Crystal Palace.

A Ladies' Committee, under the presidency of Mrs. Priestley,

A Laber Committee, under the presidency of Mrs. Prietaley, has also been formed for the upropose of holding receptions and of organizing vivils to various places of interest for the lenders who may take this opportunity of visting London. He had to be the papers to be read, and the list of excursions, entertainments, e.c., for each day, and beades this, Public Health, the journal of the Society of Medical Officers of Health (under the editorial positions) of the society of Medical Officers of Health (under the editorial positions) of the society of Medical Officers of Health (under the editorial positions) of the society of Medical Officers of Health (under the editorial positions) of the society of Medical Officers of Health (under the editorial positions) of the society of Medical Officers of Health (under the editorial positions) of the society o

papers in each section A volume of abstracts of papers will also be issued, and a special hand book, for London is being prepared by Messry Cassell and Co in French and English, this will contain several maps and plans, and will be mainly devoted to those matters which have a special innerest for members of a

those matters which have a specific to the Congress of Hygiene and Demography
After the Congress a volume of Transactions will be published, to a copy of which each member will be entitled I subscription is \(\int \), and the offices are at 20 Hanover Square.

THE ORIGIN OF CERTAIN MARBLES!

A MONGST the interesting collection of rocks brought home by Prof Haddon from Torres Straits are some flagments of wind-hlown coral sand rock from Thursday Island have a deceptively colitic appearance, and the majority of the have a deceptively colutic appearance, and the majority of the grains being of a red colour give a prevailing warm tim to the grains being of a red colour give a prevailing warm tim to the dark green, worn, and rounded crystals of augite, which are scattered irregularly inrough it. The appearance of this hand-some rock is sufficiently siriking, but it gains greatly in interest from its suggestive re-emiliance to the fanous Tiree marble, from its suggestive re-emiliance to the fanous Tiree marble, wherein likewise green grains of pyroxene are set in a flesh-coloured matrix of altered limestone. The comparison is confirmed and enhanced by an examination of thin slices, in the recent limestone the calcareous grains are found, as so commonly happens with these coral-sand rocks, to consist of rounded fraghappens with those coral-sand rocks, to comsist of rounled frag-ments of calcareous Alga, and worn tests of various species of Foraminifera, mingled with these are more or last rounded crystal, not only of green august, but into of olivine, felspar, and a findy crystalline glassy basalt, in the Tirce marble the green at the control of the control of the control of the control of the sand of the control of the control of the control of the control they show no tendency to pass, crystals of felspar are also pre-sent—some faulty fiesh, other, and these are the manuty. they show no tendency to pass, crystals or tespar are ano pre-sent—some fauly fiesh, others, and these are the majority, corroded and almost entirely replaced by calcite, only the thin outer skin of the felypar preserving a fresh appearance; in some few case, fragments of felspar partially generated by salte are met with The calcareous matrix is finely granular, possibly dolomitic, but bloched and apotted by badly defined larger tousmitte, not noticed and spotted by budy denied larger crystalline individuals of calcite, the outlines of which are some-times obscurely rounded, so that although no trace of organic structure can now be recognized, yet on the whole the appearances structure can now be recognized, yet on ne whole one appearance are such as might be expected to be presented by a coral-sand rock, which had suffered metamorphic changes Macculloch, in his detailed account of this rock, refers to its occurrence as an analysis of the control of the control

and detailed account of this rock, refers to its occurrence as an arregular mass, completely surrounded by gness; another white limestone occurs in the island, similarly disposed. It is interesting to speculate on the final result of pressure metamorphism, acting on volcanic uslands surrounded by their reefs. Thus, were the ancient granter masses of Queensland and New Guinea to approach one another, moving towards the line

A Suggestion by Profs Sollas and Cole

NO. 1135, VOL. 44]

of weakness which now forms Torres Straits, we may conceive of weakness which now horms forme Stratis, we may conceive that basic schules in great variety would arise from the rolling out of the cores and superficial deposits of the intervening volumes, while the associated coral reefs would be converted into tregular masses of structureless limestone, and becoming movied in the surrounding sentiats would be irregularly dispersed through them, so as to occur in unexpected and anomalous

positions. In conclusion we would call attention to an important paper, read in 1876, by Mr. W. I. Green, Minister of Foreign Affairs to the King of the Sandwich Islands (footnote, Journ. Roy. Geol Soc. Ireland, vol. iv. p. 140, 1877). Inter alia, he

says —
"The Hawaiian Islands are more or less surrounded by coral reefs. the island of Hawaii less so than the other, for one reason, reets, the maint of riswan ress so that the outer, not one specially the laws has kept pouring into the sea along most parts of the coast during past eenturies, and has not given the coral an opportunity to form to so large an extent as in the other islands. Now it is a fact that wherever the lava runs into the sea, or

Now it is a fact that wherever the lava runs into the sea, or wherever the waves have an opportunity of breaking against [ii], a large quantity of olivine sand is formed. The felipar, the other material of which this lava is mainly composed, gets ground up to powder and disappears—indeed, it is almost always in the content of the cont in the minutest grains to begin with, whilst the olivine, a much heavier mineral, and in grains from the size of a hean to a pea downwards, forms the main component of the sand of the sea-shore wherever the sea meets the lava, or else the olivine-sand gets more or less mixed up with the coral-sand, where the two classes of tock are in close proximity. A great deal of the olivine-sand is of the finest possible quality, indeed, it is often so fine that although a much beavier mineral than carbonate of lime, it will often, where both are washed by the waves, settle on the top of the coral sand, and I have often scraped the almost pure fine olivine sand from the top of a cornl sand beach mixture of the two sands is common over the group, extending 400 miles from Hawaii to Bird Island "Again, "there severy grade of mixture from all coral to all olivine Very often the olivine sand rock will be found to run in streaks amongst the coral sand rock, so that in the course of time, when the coral sand rock comes to be metamorphosed into a limestone or a marble, the olivine sand rock would probably suffer the change which that mineral is well known to experience—namely. into sernentine

These views will certainly commend themselves to many of hose who have come to regard Lozoon as a mineral structure With the presumption in its calcareous composition of an organic origin, there has always existed a suspicion that some such ex-planation as this might eventually be found. It is interesting to note that the streakiness which Mr. Green expressly mentions as characterizing the interlainment of the olivine and coral sand, is so frequently an accompaniment of "Eozoonal" and serpentinous limestone

IS THE MARINER'S COMPASS A CHINESE

A WRITER in the North China Herald of Shanghai devotes a learned article to detailing and discussing the facts regarding the claim of the Chinese to have invented the mariner's compass They did not learn the properties of the magnetized needle from any other country. They found it out for themselves, though it is impossible to point to the man by name who first observed that a magnetized needle points north and south. He suggests that it came about in this way. The Chinese have in their country boundless tracts of ironstone, and among these no small portion is magnetic. Every woman needs n needle, and iron early took the place of the old stone needles, and were commonly used before the time of Ch'in Shih-huang—that is, commonly used to enter the time of Chin Shurahang—ind a, more than twenty-one centuries ago. Whenever a needle hap-pened to be made of magnetic iron, it might reveal its quality by falling into a cup of water, when it happened to be attached to a splinter of wood, for example It came in some such way to a splinter of wood, for example It came in some sach way to be known commonly that certain needles had this quality. The great producing centre for magnetic iron in Tsachou, in Southern Chihit. That city was very early called the City of Mercy, and the magnetic stone produced there came to be known as the stone of Tsachou, and so Tsachou, and so Tsachou, the conditions are for a magnet Later, the Chip the City as the "City of the Magnet," mitted of calling in the "City of the Magnet," mitted of calling in the "City of the Magnet," mitted of calling in the "City of the Magnet," mitted of calling in the "City of the Magnet," mitted of calling in the "City of the Magnet," mitted of calling in the "City of the Magnet," mitted of calling in the "City of the Magnet," mitted of calling in the "City of the Magnet," mitted of calling in the "City of the Magnet," mitted of calling in the "City of the Magnet," mitted of calling in the "City of the Magnet," mitted the calling the mitted of calling in the "City of the Magnet," mitted the calling the calling the mitted that the calling the ca Mercy." The polarity of the magnetic needle would become known to the Chinece of that city and its neighbourhood first. The first who noticed the polarity would be some intelligent person who communicated the fact as an unaccountable penaltarity in an age when omens and portents were diligently sought for in every natural object and phenomenon.

seught for in every natural object and phenometon.

The earliest author who mentions the "isouth-pointing needle" lived in the fourth century is a There can be so that the property of the control of th

new circle at 3g 2 east of northinew circle at 3g 2 east of northiThe company, it will be observed, grew out of the old satroThe company, it will be observed, grew out of the stars, and prepared in the Itan dynaxy by actrologers as a
regular part of social like, especially when marriages were about
to be solennated some of the old autronomical circles are
used when she have a considered to the control of the control

braung part of the tenth, as well as the eleventh, twelfth, and part of the thriteenth centuries, Chinese junks went to Peria and Indian The strate trading to China directions to Peria the the strate of the compass, and would apply so in locard their dhows. From them the Europeans learned this useful invention.

The credit of the discovery, both of the polanty of a magnetized needle and its suitability for use by mariners at as must therefore, according to the writer, be given to the Chinese. It is the contract of the contract of

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

ROYAL COLLEG OF SCIENCY—The following scholarships, prices, and Associatiships have been awarded for the session 1890-91.—It may get's scholarships to William Allan, Thomas T Bedford, Edwin Eder, and Herbert A. Clark, second year's year's second year's y

SCIENTIFIC SERIALS.

Tits American Meteorological Tournal for June contains — An account of the meeting of the New England Meteorological Southy on Pari I was a support of the New England Meteorological Southy on Pari I will methods of predicting in the United States and Europe were first described, and afterwards local and long-range predictions were considered Papers were read by J Warren Smith, on the Signal Service weather forecasts; W. Davis, on European weather predictions, A. L. Rotch, on

the local weather predictions of the Blue Hill Observatory , the local weather predictions of the Blue Hill Conservatory, M. W. Harmgton, on weather prediction in the States and its improve nent, together with several other similar papers.—The zodiacal light as related to the aurora, by O. T. Sherman. The author gives tables and curves constructed from a large number. author gives tables and curves constructed from a large number of observations, showing (1) the relative congagation of the reclaims, showing the relative congagation of the reclaims of the relative congagation of the relative congagation of the amount by which the observed position varied from the calculated, which is probably due to addiscal light, (1) Fritz's amoral numbers for Europe south of the polar circle; and (4) has relative numbers for Europe. The conclusions drawn from the tables are that from 1806-27 there was noobservation of the the tables are that from 1800-27 there was no observation of the confacil light, sight and register variation of the earth's motion, confacil the sight and the sight of the sight and the period of elongation of the zodiscal light corresponded with a maximum acceleration of the earth's motion, and a minimum in the autors. And further, that at the time when the zodiscal light was beyond the earth's north, the autorias were few and the sight was beyond the carth's north, the surrors were few and diminished in number -Farwell's rainfall scheme This article (which is unsigned) states that Senator Farwell carried a Bill (which is unsigned) vales that Senator Farwell carried a Bill through the last session of Congress, for testing the possibility of the artificial production of rain by means of explosions. The experiments, which are soon to be tried, are intrusted to the Agnoultural Department, the officials, however, are said to have little confidence in the success of the experiment Mr. Fernow. Chief of the Division of Forestry, gives a long report upon the proposal, together with a summary of the literature of the subject

proposal, ogeniew kina a unumany of un-intensace or ine subject.

American Teamail of Science, Julpe-The solar coons, an measure of the Newtonian potential function in the case of of the author's revearches into the laws which regulate the development of the vanous coronal forms—Newtonire and elevation of the various coronal forms—Newtonire and rectoring, two new minerals of the kaloniant group by R N Brackett and V Francis Williams—Taking the composition of kaolin as AJO₂3-StO₂3-H₂O, the following series of hydrous

silicates of alumina may be derived by eliminating or introducing a molecule of water —

Percentage Composition

	41,01	SiOg	H_O
(I) Al ₁ O ₂ , 251O ₄ , H ₂ O	42 52	49 99	7 49
(I) Al ₂ O ₂ , 25:O ₂ , H ₂ O (2) Al ₂ O ₃ , 2S:O ₂ , 2H ₂ O	39 57	46 56	13 93
(3) Al ₂ O ₈ , 251O ₂ , 3H ₂ O	36 98	43 47	19 55
(4) AlsOs, 251Os, 4H,O	34 72	40 82	24 46

From the facts and considerations stated in the present paper if rrom no sects and considerations stated in the present paper it appears probable that three members are known out of the four in the above series, vis. (1) rectorite, (2) kealin and members of the knohinte group, and (4) newtonite —On the intensity of sound, if the energy used by organ-pipes, by Charles K Wead. From the results of experiments with different organistops. wean rrom deresuits of experiments with quinterent organistops out, it appears that no exact conclusion can be drawn from the loudness of the sound as to the relative quantity of wind required to blow pipes of different construction, thus, the soft Dulciana stop of the organ upon which the experiments were performed took more than half as much wind use the comparatively load Open Dispasson, whist the pages of the Trumpt, value required less energy than any others sounding the same note. The results obtained in the case of different papes of the same stop addicate that the volume of air used per second, and therefore indiciate that the volume of air uses per second, and therefore the energy expended per second, varies as he 4-power of the vibration-ratio —New analyses of astrophyllite and tachellikinte, by L. E. Eakins. The analyses give Kr. (K.)(Si(OL)₄) as the general formula for astrophyllite. This agrees with that found by lirogger from a discussion of analyses by Backstrom and toy lirogger from a discussion of analyses by Mocsstrom and Konig Tscheffkintle does not appear to be a mineral in any strict construction of the word, but merely a mixture—The minerals in hollow spheralities of rhybite from Glade Creek, Wyoming, by JP Jüdings and S. L. Penfield. The authors find that in the rhybite investigated faysite occurs in association and that it the trajoute investigated asylate occurs in association with abundant quarter of a peculiar development, as the result of the mineralizing action of vajours in the cooling and claw. In certain hollow spherulists the fayalite is replaced by homblende and biotite—Bernardinite is it a mineral or a fungus; to Joseph Stanley Brown From Mr. Drown's examination if appears that the mineral resin from San Bernardino County, Chilorani, destroided by Prof Stullman in the American Journal twelve years ago, is the fungus *Polyporus officinalis*, Fries.— Development of Bilobites, by Dr Charles E Beecher.—

Gmelinite from Nova Scotia, by Louis V. Pirsson The optical characters, cleavage, and chemical composition of this mineral have been studied The result of the crystallographic work points to a distinct difference between it and chabazite, but with regard to a distinct difference between it and chabasite, but with regard to turning and chemical constitution the two appear to be identical. Indeed, gmelinite seems to bear much the same relation to chabastic that ensistinct does to hypersthene.—Analyse of kemutet, kenste, and plessite from the Welland meteoric iron, by John M Davidson. The conclusion is arrived at that in the Welland sideroline only two distinct nickel iron alloys occur, was kamasize and Lennit, and that the so called plessite. is merely thin alternating lamelie of the two

American Journal of Mathematics, vol xiii, No 4.—In this number J. Perrott's "Remarque au sujet du théorème d'Euclide sui l'infinité du nombre des nombres premiers" is d'Euclide sui l'infinité du nombre des nombres premiers "in continued from No, 3, and coolcided, the author promung a further article on "I application du procéde du géomètre grec à following papes also appear ...Elber squiras, by Karl Peanon, an attempt to specalize the form of ether motion which forms an attempt to specalize the form of ether motion which forms an attempt to specalize the form of ether motion which forms metric which represents a vector, by C. H. Chapman, The fordamental teas a night the internal vector function of a vector fordamental teas no that the linear and vector function of a vector. is simply the matrix of the third order -Sur une forme nouvelle de I équation modulaire du huitième d'gré, par F Brioschi — The index to vol xiii is appended to this number, which concludes it,

SOCIETIES AND ACADEMIES. EDINBURGH

Royal Society, July 2007. The Market Lird McLaren, Vice Prevident, in the clair—Mr. John Auther need a page on the solid and liquid particles in clouds (see p. 279, July 23).—Prof Tatt communicated a pager by Prof Chrysial on a demonstration of Lagrange's rule for the solution of the linear partial differential equation, with some historical remarks on defective demonstraons hitherto current Prof Chrystal's proof is purely analytical Prof Tait remarked that, on quaternionic principles, the problem may be regarded as follows. Let the equation be

Pp + Qq = R

where P, Q, and R, are given functions of x, ν , and z, and p, q, represent respectively the quantities dz/dx, dz/dy. By the in troduction of a new variable, u, this may be put into the form

$$P\frac{du}{dx} + Q\frac{du}{dy} + R\frac{du}{ds} = 0.$$

But du/dx, du/dy, du/ds, are proportional to the direction cosines of the normal to the surface u=c, and therefore P, Q, R are proportional to the direction cosines of a tangent line to Hence we deduce, as the equations of a curve which hes wholly on the surface.

$$\frac{dy}{dt} = \frac{dy}{dt} = \frac{dz}{R}$$

The integrals of these equations are known to have the form v = a, $w = \beta$, where a and β are arbitrary constants. The intersections of these surfaces fill space with a set of lines, and the problem is to find a single general set of surfaces upon which the proofem is to find a single general set of surfaces upon written these lines will lie. Their equation is v = f(v), where f is an interest of the surface of the sur secordance with the direct observations of Drs. Ramsay and Voung. He has also applied the virial method to systems of doublets, triplets, &c. The close correspondence of the results executed to the results of the res accordance with the direct observations of Drs Ramsay and

saturated vapour He has reduced the difficulties of the probsaturated vapour 176 has reduced the dimediates of the pro-lem to the evaluation of certain definite integrals—D: plou-hourary communicated a paper by Mr. J. W. Gregory, of the British Museum, on the Maltees fossil Echinoidea, and their evalence on the correlation of the Maltest rocks. In this apper the fossil Echinoidea of Malta are revised, and many additions to the fauna made by the description of material recently collected. Several genera new to Malta are recorded. and also some species previously known only in Italy. Some changes in nomeaclature are advocated thus, as the author accepts the zoological use of the generic name Echinanthus, as me wone-Breynella—is proposed for the genus known to palæontologists by the former term — In regard to the age of the palæontologists by the former term in regard to the age of Maltese beds, the author agrees with Fuchs as to the Lower Maltese beds, the author agrees with Fuchs as to the Lower Coralline limestone being clearly Oligocene; the overlying Globigerma limestone is assigned parily to the Aquiannan and parily to the Langhten as no sharp line of division can be drawn hetween these two series, the exact limits of the Oligodrawn hetween these two series, the exact limits of the Oligo-cene and the Miocene in Malta cannot be precisely determined. The blue clay appears also to belong to the Langhien, and to be hardly entitled to separation from the underlying Globigerina limestone, the greensand is referred to the Helwettan, and the innessone, the greenand is referred to the Helvetana, and the Upper Cortlina limestone to the Tortoman. The relations of Echimod fannas of the different horizon to those of the correct and it is argued that deep sea conduitors prevailed in different areas at different times, hence they show merely a sense of local subsidicace, instead of one great regional depression.—
Prof. Ewart communicated the first part of a paper on the interest sense; one of the paper of the pap dealt specially with the sensory canals - Prof. Tait commun-cated a paper, by Prof. C G Knott, on the electric resistance of cobalt at high temperatures. The cobalt on which Prof Knott somet at high emperatures. The coolet on which Prof. Knott experimented was in the form of a thin strip cut from a sheet in taming possibly I per cent of carbon, 0.15 per cent of taming possibly I per cent of carbon, 0.15 per cent of silicon, 0.75 per cent of ron, a very small percentage of manganese, and perhaps of percent of fron a undetermined metal. The formula r= art, where r is the resistance and t is the temperature, closely represents the results at temperatures above too. C This law is identical with that which holds in the case of nickel, but the rate of variation is not so great in cobalt as it is in nickel. When first heated to a very high temperature, profound changes take place in the metal as regards its change of resistance with temperature. The metal resembles nickel and iron in that the rate of variation of its resistance increases rapidly from in tenture are observed in the state of the tenture of the te the metal into small pieces, and packing them into a siphon-shaped glass tube. Gentle heating fused the pieces, and so a solid rod was formed. The other wires were fused into its ends The line of this specimen of cobalt, on the thermo-electric The line of this specimen of cobalt, on the thermo-electine diagram, lay, at ordinary temperatures, above that of the specimen of nickel which Prof. Tast used in the construction of the diagram, but a entural point existed at too; because of the greater steepness of the cobalt line. The slope of the line is the greater sheek has we then constructed, with the exception of that of the professional properties which have been considered to the construction of the line of nickel. The company of the line of the line of the company of the line of netic fields, although Right has shown that its resistance alters in such fields

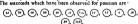
SYDNEY.

Royal Society of New South Wales, May 13,—Civil Engineering Section Meeting —Mr. C. W. Darley in the chair—The inaugural address was delivered by the Chairman; and a paper read on researches in iron and steel, and working stresses in the chair was the Pack When the pack When the pack When the pack was the pack when the pack was the pack when the pack was the pack was

paper read on researches in iron and steet, and working stresses in structure, by M. Warrer. Whose President, in the chair.—
Six new members were elected.—The following paper was read—Notes on the large death; state among Australna sheep in country affected with Cumberland disease or splende fewer, by M. Adrien Loft, Director of the Pateur Institute of Australia.—
M. Adrien Loft, Director of the Pateur Institute of Australia and State of Australia and Australia and

PARIS

Academy of Sciences, July 20 —M. Duchartre in the chair —The life and works of the late Prof W Weber, by M Maccart —Observations of minor planets, made with the great meridan instrument of Paris Observatory during the second half of 1890 and the first quarter of 1891, by Admiral Mouchez The asteroids which have been observed for position are



—The third meeting of the International Committee of the magnetic of the heavens, pre-criation of the Proceedings, by the same author.—Elements of the elliptic comes. Switt (1858 VI) and Elements of the elliptic comes. Switt (1858 VI) and Elements of the elliptic comes. Switt (1858 VI) and Elements of the elliptic comes. Switt (1858 VI) and the Elements are derived from a the essential committee of the elliptic comes. Switt (1858 VI) and the elliptic comes are described from the elliptic comes and those of long times are described from the elliptic comes and the elliptic comes are described from the elliptic comes and the elliptic comes and the elliptic comes and ellipt

 Weight of air analysed
 Grms
 Grms
 3 437
 3 5551

 Weight of oxygen which combined with phosphorus
 0 7958
 0 8249

 Percentage proportion of oxygen
 23 244
 23 303

The mean of these values is 32 244, or, roughly, 2; 32, which may therefore be taken to represent the presentage of oxygen in parfiel air. The composition by volume is stated as a rich of some particular of the process of the process. And oxygen at 10 20 per cent.—On when selentie, a current of dry hydrogen selentie over crystallized silicon at a current of dry hydrogen selentie over crystallized silicon at a carent of dry hydrogen selentie over crystallized silicon at a seem metallic appearance, and apparently not volitile at the temperature of the experiment. In composition, whend by point of certain organic binary system, thydrocartons), by M. Lo Vigion—Study of the solid products resulting from the outdation of drying oils, by M. A. Livache—On a new method of testing for phench, by M. E. Carte—On a consecutive of the control of th

under the influence of luminous encirations. These movements are apparently due to a reaction of the reins at the mongast when light strike it.—On the investment of the mongast when light strike it.—On the development of the mesoderm of Crustacca, and on that of us derived organs, by M Lous Roule —On the homology of the pelal and cephalic appendices of Annelide, by M. A. Malaquin.—On the terms artifact of the white worm, by MIL Pillnear and

Rungsers

Academy of Sciences, May 5—M. Plateau in the chair,
—Lunamarine, a new glucosate from Lunw Unitatazismus,
picking hydrogen oyaude on hydrolysis, by A. Jorness and E.
Harn. The method of preparation from lunes are seen that
picking hydrogen oyaude on hydrolysis, by A. Jorness and E.
Harn. The method of preparation from the
with amyedin, but the table of properties discloses many important differences, notably the solubility of the new hody in
old water, it melting at 13, "motion discomplishing," and the
old water, it melting at 13," motion discomplishing, and the
figures C. 478 8. II, 68 8. II, 55, 08, 198 9—On the
piancone of decoybenzon, by M. Delaces. The author shows
figures C. 478 8. II, 68 II, 55, 08, 198 9—On
the
piancone of decoybenzon, by M. Delaces. The author shows
the reduction of decoybenzon, by M. Delaces. The author shows
163° He captains the discordance of the remits of MM.
Limproint and only in the control of the
Limproint and only melting point at 156°—On the constitution of a
minet the melting point at 156°—On the constitution of a the former having obtained the mixed bodies, and hence deter-mined the melting point at 156 —On the constitution of a-benzopinacoline, by M Delacre The author gives a complete chemical and physical study of the properties of this body; he coocludes that a benzopinacoline is not a pinacoline but the ether of benzopingcone, and that its constitution would be expressed by the formula

$$(C_0H_0)_2 \cdot C - O - C \quad (C_0H_0)_2$$

 $(C_0H_0)_2 \quad C - O - C \quad (C_0H_0)_2$

thus making it molecular weight double that he previously assaged to \$B-beanopurscoline. The duts given in the paper for comment of the paper for the paper and etners. Acetic annyance was employed as energying agent, as by its use no water was produced, and thus the complication of the problem by the introduction of reversible reactions was avoided. The velocity of etherification of methyl actions was avoided The velocity of etherinciation of methyl alcohol is the greatest; it wusbaltiation of any element or group of elements for hydrogen in the molecule CH,OH invariably decreases the velocity of the resultion—Theorems on the curvature of algebraical curves, by ProC Cl Serwais—On the "statractive spheres" in some vegetable cells, by E de Wildeman—Crystallographic note on abute from Revin, by M. A.

Academy of Sciences, May —On the expansion and com-pressibility of atmospheric air, by A. W. Witkowski. The author has made experiments with air between the temperatures author has made experiments with air ofcrewen the temperatures too and -145°C, and at pressure up to 190 attomorphers. The coefficient of expansion (a) has been found at the constant temperatures too, '0', '35', "78' 5, -103', 5, -130', -135', -140', and -145', by varying the pressure. The values obtained for these nine isothermals are tabulated and represented graphically. From the isothermal curves it appears that the coefficient of From the isothermal curves it appears that the coordinate of expansion increases up to a maximum meach case, and then diminishes. The increase is most rapid near the liquefaction points. All the curves tend towards a point the co-ordinates of which are p = 1 atmosphere, and a = 0 00367. The values expressing the compressibility of air have been calculated from the expansion coefficient.—An electrical thermometer for low temperatures, by the same author. The fact utilized in the construction of the iostrument is the variation of the resistance

of a platinum wire at different temperatures. From the experiment it appears that this is about 2 ohms per degree R is therefore easy to obtain a sensibility of \(\phi \) of a classificated between the temperature and the electrical resistance. The relations between the temperature and the electrical resistance was to be a sensitive of the electrical resistance was the electrical resistance was the electrical resistance and the electrical resistance was the electrical resistance was the electrical resistance and the electrical resistance was the electrical resistance and the electrical resistance a

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Pamons in Count International Presentation 11 Section of is Care Paccarphique do Carl (Parts, Gauther-Villar). Solutions of the Experiment of the Carl (Parts, Gauther-Villar). Solutions of the Experiment of the Carl (Parts, Gauther-Villar). Solutions of the Experiment of Carl (Parts, Gauther-Villar). Solutions of the Paccard of Carl (Parts) of the Intel (Parts) of Carl (Parts) of the Intel (Parts) of Carl (Parts) of Car

CONTENTS.	PAGE
The History of Chemistry By Prof T. E Thorpe	1 280
Progress in Elementary Biology. By Prof E Ray	, .
Lankester, FR.S	. 290
	. 292
Our Book Shelf:-	
Guyau · "Fducation and Heredity "-F G	292
Carus "The Soul of Man"	- 293
Letters to the Editor:-	
O'Re:lly The Great Comet of 1882 (With Diagram)—Serence	293
E. Bishop	
Copepoda as an Article of Food —I, C Thompson	293
Meteorological Phenomenon.—Francis Galton	294
FRS	
Refraction through a Prism (With Diagram)-Rev	294
	. 294
Further Notes on the Anatomy of the Heloderma.	· 294
Dr R W. Shufeldt	. 204
The Discovery of the Standards of 1758	295
Maxwell's Electro-magnetic Theories. By Prof	-93
A, Gray	296
The Origin of the Flora of Greenland By Clemen	. 290
Reld	299
The Sun's Corona, By Dr. J. M. Schaeberle, J	-77
Norman Lockyer, F.R.S.	300
Notes	301
Our Astronomical Column:-	3
Observations of Sun-spots and Faculte	305
Stars having Peculiar Spectra	305
The Institution of Naval Architecta	305
Seventh International Congress of Hygiene and	3.3
Demography	207
The Origin of Certain Marbles, By Profa Sollas	
	308
Is the Mariner's Compass a Chinese Invention?	308
University and Educational Intelligence	309
Scientific Serials	309
Societies and Academies	310
Books Pamphlets and Serials Received	312

THURSDAY, AUGUST 6, 1891.

A PHYSICIST ON COLOUR-VISION.

Colour-Measurement and Mixture By Captain Abney (London. The Society for the Promotion of Christian Knowledge, 1891)

HIS interesting little book extends over only 200 pages, but is full of careful and important observa-It is, in fact, a summary of the results arrived at by the author during his careful and laborious investigation of the properties of the spectrum. It forms one of the "Romance of Science" series published by the SPCK., a series intended " to show that science has for the masses as great an interest as, and more edification than, the romances of the day" Now, though the earlier portion of this book could be understood by anyone, we venture to think that the second half is for the most part so technical that the full meaning and value could only be appreciated by those who are more or less conversant with the methods of experimenting on colour. To those who are familiar to even a slight extent with the technicalities of colour experiments, the characteristic of the book is its extreme lucidity. We are carried on from point to point, until, when we look back on the closed book, we find we have travelled over the greater number of the problems of colour-vision almost without effort. It is a book which will not appeal to the masses, but should be read by every physiologist and physicist interested in

There is yet another reason for the interest which attaches to this work, necessitating a faller notice than if it were simply a popular disguisition on colour. It is the record of a careful series of experiments by an eminent physicist, firmly convinced of the truth of the Young-Helmholtz theory of colour vision. The voluminous work of Hering and his pupils is not once mentioned through-out the whole book, although Kong's later publications receive due notice. In fact, if space permitted, we cannot imagine a book more calculated to form the basis of a fruitful discussion on the ments of the rival theories than that now before us. For both the problems of colourvision, and their solution according to the Young-Helmholtz theory, are definitely and clearly stated.

The book opens with a description of the methods used to obtain a spectrum, and a consideration of its properties with especial reference to the ultra-red and ultra-violet rays. The apparatus used by the author to investigate the three fundamental properties of colour—hue, lummosity, and purity—are described in detail. Absorption and interference are then touched upon in their relation to colour, and experiments are given to show that the colour of a body is due to its refusal to transmit or reflect certain rays of the spectrum. This is followed by an interesting chapter on scattered light, with especial reference to atmospheric effects, and a pretty lecture-room experiment is described to show that the change in the colour of the sun when on the horizon is produced by small particles in the air.

The author then passes on to consider the second property of colour—luminosity; and the luminosity of the apectral colours is measured as follows. The light from a

certain portion of the spectrum passes through a slit which cuts off the remainder of the spectrum. A portion of the same white beam which was decomposed by the prisms is reflected on to the same screen as the monochromatic beam, and an upright rod is interposed. This rod throws two shadows, whose intensity is compared after the manner of a photometer The luminosity of the whole reflected beam is greater than that of the coloured beam, and a rotating diaphragm, with variable sectors, is therefore interposed in its course. By altering the size of the sectors, the intensity of the white light is diminished, until the luminosity of the shadow it casts is equal to that cast by the monochromatic beam. The luminosity is then read off in terms of the segment of the circular diaphragm which remains open when the luminosity of the two shadows is equalized. The luminosity of all the principal points in the spectrum is measured on this plan Subsequently the luminosity of a combination of red and green is shown to be could to the sum of the luminosities of the saine red and green determined Three colours, A, B, and C, are chosen, separately which, when combined, make white of a certain intensity, W; and the author shows that if the luminosity of the combined light A + B be subtracted from the luminosity of the white light. W. the remainder exactly equals the luminosity of the third factor, C

A curve of luminosity can be constructed in this manner for the whole spectrum, and its maximum is found to he on the yellow side of the D line. A similar luminosity curve is given for an observer who was what is ordinarily called red-blind. On this curve the red end of the spectrum is shottened, and the maximum luminosity falls nearer the green than on the curve constructed for a person with normal colour-vision. These facts are capitated as follows. To the red-blind observer red is invisible, and therefore the luminosity of red is abolished; the luminosity of yellow, which is composed of red and green, is also duminished, and thus the maximum of the curve moves towards the green.

This question of luminosity is intimately associated with the theory of the value of white in the system of colour. The author discusses later on in the book the abolition of colour by white light, and examines the extent to which white light can be added to a colour without being perceived. He finds that both depend on the luminosity of the colour, and formulates the law that "the extinction of every colour is effected by white light that is 75 times brighter than the colour." Again, he finds that a large proportion of white light can be mixed with yellow without being perceived, whilst a very small proportion of white added to blue is at once apparent

An attempt is made to explain these facts on the Young-Helmbott theory; but the work done by Hillebrand! under Henng's gudance, makes the explanation offered very improbable. Hillebrand used an apparatus in which one half of the field could be illuminated by a monochromatic spectral colour, whilst the other half was illuminated by white light. The observer shelded one eye from the light for a considerable time, so that it was ultimately brought into a condition of complete rest. Now if he looked at a field field with monochromatic

^{4 &}quot;Ueber der specifische Helligkeit der Farben," Seleb d h Akad d Wissenschaff, in Ween, February 1889

light of moderate intensity with the rested eye, it appeared to him colourless; and by suitable adjustment he could make an absolute match between the half of the field illuminated by monochromatic light and the other half illuminated by white light from the same source. Thus, as the whole spectrum appeared colourless, he was able to construct a curve of luminosity for the spectrum by matching it with the white light in the other half of the field. The maximum of this curve lay in the green A glance with the unshaded eve at once brought the colour into view, although the field was unaltered. But as soon as the colour came into view, he noticed that the luminosity of the coloured half no longer matched that of the colourless half of the field If yellow or red were the colour chosen, the luminosity of the coloured half of the field appeared to exceed that of the colourless half, whilst if green or blue were selected the exact opposite was observed. Moreover, as soon as the colours of the spectrum were appreciated, the maximum luminosity shifted into the vellow, and the curve he then obtained closely resembled that constructed by Captain Abney and other observers. Thus we must conclude that every part of the spectrum is capable of exciting the sensation of white apart from its specific colour, and that the maximum sensation is produced by a certain point in the green As soon, however, as the colour becomes apparent, this sensation of white is either increased or decreased by the specific luminosity of the colour The luminosity of the spectrum, as determined by Captain Abney, is the algebraic sum of two factors. Firstly, the power which every part of the spectrum possesses of exciting the sensation of white; and secondly, the specific luminosity of the colour sensation itself, which is a positive quantity on the red and yellow side and a negative quantity in the blue

If this explanation for the difference in the two curves be correct, a person who was completely deficient in colour-sense would construct a luminosity curve for the spectrum differing considerably in the position of its maximum from that given by Captain Abney in his book. The curve obtained by Konig I from a man to whom vellow, blue, green, and red were invisible, to whom the whole spectrum appeared in varying shades of white. shows that this is the case The maximum luminosity lies in the green, over the line b A comparison of this curve with that given by Hillebrand for the normal eye at rest reveals their almost absolute identity. The existence of this form of colour blindness can only be explained with extreme difficulty on the Young-Helmholtz theory; whereas Hering's hypothesis, that white and black form a colour pair analogous to red and green, yellow and blue. not only renders the existence of such a condition probable, but also easily explains Hillebrand's results.

The author passes on to show that white can be produced from the mixture of three spectral colours, and ultimately defines a primary colour as one which cannot be formed by the mixture of any other colours. The three primary colours he selects are red, green, and

violet; for yellow is formed by a mixture of red and orgene, blue by a mixture of green and violet. But he he warms us from assuming that the three primary colours warms us from assuming that the three primary colours (p. 138). On p. 150, or red (between C and the lithtum line), violet (close to G), are selected as furnishing two primary sensations, whist "all three fundamental sensations" are excited by the end of the primary sensation was the way of the primary sensation will be settled by the way of the primary sensation was the primary sensation where the green is mixed with

Now, to say that ap-ctral green excites the sensations of red and voice seems to us radically faise. For when speaking of sensations we leave the realm of physics, and the sole test of the sensations sectied by a portion of the spectrum is the colour which we perceive when light from that part impages on the retina. No one who examines spectral green will say that it gives him the sensation of erd or voice, but rather that the greater part of spectral green appears to be mixed with either yellow or blue. Again, a primary sensation must be one which gives us the sensation of one colour only. Now every eye sees in voice both blue and red. Thus, whether voice be a primary colour from the physical point of view, physiologically speaking it is anything but a primary sensation.

Though violet fails to answer the test of a primary in colour sensation, a point can be found both in the yellow and the blue of the spectrum, from which the sensation of one colour only is obtained. But throughout the book we find repeated mention of the formation of yellow by the mixture of spectral red and spectral green. How can this be reconciled with the acceptance of yellow as a numary sensation?

To most eyes, the red of the spectrum yields to a greater or less extent the secondary sensation of yellow. Take such a red, and gradually add minute quantities of spectral blue The yellow will gradually disappear, and a red will be produced, which yields the sensation of red only, untinged with either vellow or blue. Take a spectral green, which is also slightly yellow, and treat it in the same way. If we now mix the absolutely pure red with the absolutely pure green, white is produced, not vellow And now we can understand why spectral red and spectral green can be made to form yellow For both the red and the green, which, when mixed, form yellow, when separate give the secondary sensation of vellow in addition to that of their principal colour Thus, when mixed, the pure red annihilates the pure green, and yellow only remains. Measured by this standard, the primary colour sensations fall into two groups, in which each colour is complementary to the other Firstly, red and green, from which all secondary sensations of yellow and blue are absent, and secondly, yellow and blue, which do not give the secondary sensations of either red or green

Colour-bindness is brought in to support the Youngclimboit theory, but the author has obvoouly not had the opportunity of investigating many cases of this affection. He speaks of green-blindness, in which the sensations of red and violet are present, but not that of green, and of red-blindness, in which the sensations of green and violet are present, but not that of red; and gives measurements to show that in the latter class of cases the spectrum is shortened.

Die Grundempfindungen u ihre Intensitäts-Verbistung im Spectrum," Stith d k preuz Ahad d Wissenskhaft in Resin, zuzik, 1888 Hering has under shown, by investigating a similar case of total colour-bladonst, how closely the curve of humnosity agrees with that green by Hildbrand I be account of this interesting case has not yet beer

Now. Hering 1 has particularly investigated this portion of the subject, and explains the existence of two forms of colour-blindness as follows. He finds that persons with a normal colour-vision can be divided into two groups The one class perceive yellow, the other blue, with exceptional ease, probably owing to a difference in the pig-The difference mentation of the media of the eye between the two groups is best seen with spectral green; for a green can be found which appears at the same time yellow-green to the one, blue-green to the other To an observer with strong yellow vision, almost the whole of spectral red appears to be tinged with yellow, whilst a member of the second group, whose strong sense of blue prevents his seeing the yellow, pronounces the greater part to be pure red. Thus, the pure red and the pure blue are radically different colours for the two groups. Now, it is found that the pure red and the pure green formed for an observer with a strong sense of yellow appear grey to one who is what is called green-blind . whilst, on the other hand, the pure red or the pure green of the observer with a strong blue sense appears colourless to one who is red-blind A red which is invisible to one who is "red-blind" is evidently coloured to a patient who is green blind, and he speaks of the colour he sees as red But if a minute proportion of blue is added, the red gradually becomes purer until it becomes free from vellow to those of us who have a strong yellow sense As the red becomes purer, our green-blind patient complains that the "red" is fading, and when finally the red is quite pure he matches the colour he sees with a grey, and says that the colour has gone Thus, there is no fundamental difference between the red- and the greenblind Neither group can perceive red or green only difference between them is one which we find amongst normal-sighted persons-namely, a different visual acuity for yellow and blue The "red" of the green-blind is in reality the secondary sensation of yellow yielded by almost all the reds in nature, differing from the ordinary yellow in its limited power of exciting white This peculiar yellow he has learnt to associate with what others around him call red, and he only betrays his affliction when all yellow is climinated from the colour he calls red Thus, a consideration of colour-blindness again leads us to throw red and green, blue and yellow, together into two groups as primary colour sensations

Simultaneous contrast is touched on very superficially, and successive contrast is scarely mentioned, yet the author again grasps at the three-colour theory to explain the few phenomena he mentions. Yet it is notorious that the Young-Helmholtz theory fails to afford any adequate explanation of the phenomena of contrast. It was by an ingenious contrast experiment that Hering produced such a striking confirmation of his views before the Physiological Congress at Basle, and placed the three-colour theory in a dilemma from which its ablest exponents have not yet succeeded in extracting.

In conclusion, the book before us is an admirable summary of a valuable series of experiments. We can scarcely imagine that it will appeal to the public in

general But it should be read by those who are interested in the phenomenon of colour-vision, and the fact that the author frankly accepts the three colour theory and ignores the work of Hering does not, in our opinion, detract from its value. For the book thus becomes an admrable statement of the strongest portion of the physical theory of colour by one of the ablest of English hysticitis

POSITIVE SCIENCE AND THE SPHINX

Riddles of the Sphinx A Study in the Philosophy of Evolution By a Troglodyte. (London, Swan Sonnenschein, 1891)

THESE be old old nddles that the Sphinx propounds I and the Tropledye attempts to guess, in the volume before us, none other, indeed, than the What, Whence, and Whither of man and of the world There have been other guesses in the past, there will be other guesses while time last, each guesser thinks his own guess nearer the true answer than any other, his neighbours mostly sinke, unless his guess chances to be something like their own, and the Sphinx looks on with stony stare, imperturbable, giving no hints.

So soon as man, as man, looked out upon the world, and began dimly to realize the first personal pronoun, the nascent reason, or, if the phrase be preferred, intellectual faculty, demanded, for the first time in the history of the development of consciousness, an explanation Man, then as now the chief centre of interest to man must thenceforward not only live and act, but must seek to explain his life, and his activity Yesterday the tribechief went forth a living man, feared by all . to-day his body is brought back, helpless, lifeless, and a hog spurns it with his shout How account for this? How explain this change? Something there was about the man vesterday which made him totally different from the mere mass of clay that to-day already needs hustling out of sight That something, call it soul, spirit, energy, life, what you will, has departed Whither has it gone?

This question, eminently natural, almost inevitable, opened the way for reason's first blunder to enter and to become a fruitful mother of children. Reason, in the exercise of the new-born analytic faculty, distinguished between the mere body and the informing something through which it was a living body, between the material substance and the spirit-energy which was associated with that substance during life. But reason also jumped to the conclusion that what were distinguishable in thought were also capable of separate existence in fact The matter remains in the corpse, but the something, the spirit-energy, has escaped, to lead a distinct and independent existence. In justification of this conclusion the phenomena of dreams were no doubt adduced as evidence. While the chief's body was lying stark and stiff, his true self, his spirit-energy, appeared by night to more than one of his chosen followers Thus the dream seemed to support the false conclusion of the nascent reason, which had not yet learnt to distinguish without dividing.

It has cost positive science much labour, and not a few hard blows, to establish, by detailed work in physical science, biology, neurology, and psychology, the ille-

[&]quot;Zur Erklörung d Ferbenblindheit" (Prag. 1880), "Ueber Individualle Vorschiedenbeiten des Farbenannes" (Prag. 1880) Ergebruchten Vorschung z. dagnose d Farbenblandheit, "Ueber d. Erklörung d. periphären Farbenblindheit," "Enseinige Storungen d. Farbenauenes," Arktir f. Orkhälmeiter, axxiv

gitimacy of this conclusion. Now we distinguish further. but no longer divide. We distinguish between the material substance of the body and the energy of molecular motion during life; and, further, between the molecular motion of the grey matter of the cerebral hemispheres and the concomitant manifestation of consciousness. But although consciousness is distinguishable from molecular energy (and the distinction is absolute), it is not, so far as positive science can say, divisible therefrom. No physicist holds that the special modes of energy-we iftean the particular groupings and interactions of energy -which characterize the functioning of a man's brain, escape from the molecules at death, and henceforward persist divorced from matter. We cannot, however, add that no psychologist holds an analogous doctrine concerning consciousness But we contend that no psychologist is justified on positive grounds in holding such a view That something called soul or spirit escapes from a man's body at death, and henceforward persists, divorced alike from matter and energy, is a view to which positive science as such gives no support. It is held by those who hold it on quite other grounds. The conclusion to which positive science points (and we include among positive sciences psychology, which deals with consciousness as existent) is that consciousness, though distinguishable from energy, is known only in association with certain forms of energy in organic tissues

But this is a conclasion which is ignored by the Troglodyte. He professes to give us a "philosophy of evolution" which he himself describes as "the first perhaps which accepts without reserve the data of modern science." His theory of a Transcendental Ego, his suggestion that "matter is an admirably calculated machinery for regulating, limiting, and restraining the consciousness which it encaces", his conception of a graduated unmortulity, from that of an aniocha up to that of man, his attempted rehabilitation of the view that force-atoms are monads "endowed with something like intelligence, and thus enabled to keep their positions with respect to one another", all this, and much besides, seems to us completely off the lines of modern scientific davance

But it may be said that such conceptions, though unnecessary for positive science, may be nocessary for a philosophy which endeavous to go beyond and get behind science. In reply to this we can only say that we regard such conceptions as not only unnecessary to the positive science, but unwarrantable intrusions into her domain. They form part of a different scheme of thought. The muddling together of positive and metaphysical conceptions is provocative of nothing but confusion and had temper.

The introductory chapters of his first book, in which he author attempts to hound on positive science from agnosticism, through universal scepticism, to a gloomy pessimams, seem to us laboured and inconclusive, though there are incidental positions here and elsewhere with which we arean complete accord. With dogmatic Agnosticism and the Cult of the Unknowable (capital letters indispensable) we have but little sympathy. But this is no necessary part of the attitude of positive science, which seems to us briefly as follows in the first place its followers take their start from the measurable and verifiable base-line of perceptical expensione, from the ordinary

facts of daily observation: and they utterly refuse, at this stage of the inquiry, to listen to the metaphysicians who hoot from their cloud-land, "But you haven't vet proved the existence of matter, or explained how it is possible to perceive or know anything at all," Starting, then, from the base-line of perceptual experience, they analyze phenomena, digging down by wise abstraction and the ignoring of unessentials, to deeper and deeper concepts, until they arrive at those universal abstracts which cannot be got rid of in thought without reaching nonentity. Happy they who in this procedure escape the analyst's fallacy-the supposition that the results of abstraction have a fuller reality than the phenomena with which they started The analyst needs often to be reminded that the perceptual rose, with its delicate scent, its rich colour, its soft petals, is certainly not less real than the vibrating molecules which remain to his thought when, as physicist, he has stripped it of all its own peculiar charms.

Thus positive science in its deepest analysis brings us down to matter, and energy, and consciousness. If a number of metaphysical questions are intruded at all sorts of stages during this process, the result will be such confusion as the Troglodyte unconsciously exemplifies in his chapter on scepticism, a chapter in which some stress is laid on, and some capital made out of, the false psychological conclusion that conceptions cannot be derived from experience. Should the author ever come to grasp that the law of psychogenesis is one and indivisible, and sweeps through perceptual and conceptual processes alike, he will have to rewrite much of the "Riddles of the Sphinx" But, as he himself tells us, "the minds of most men are fortresses impenetrable to the most obvious fact, unless it can open up a correspondence with some of the prejudices within "

When positive science has dug down to basal conceptions, then, and not till then, in logical order (but, of course, far earlier in historical order) arises the question, "But how does it all come about? What is the origin and meaning of it?" We quite agree with the Troglodyte that this question must arise in the mind of every man in so far as he is a thinking man. The question, "How does it all come about?" however, presents two faces It may mean, "How can we explain the fact of knowing?" And the solution of this problem is, we agree with Mr Shadworth Hodgson in maintaining, the true business of philosophy But even supposing that philosophy explains in some sense the process of knowing, there still remains the question in its further aspect, "But how does it all come about?" To this question, positive science as such answers, or should answer, humbly, and with no parade of capital letters, "I do not know"

And is that the end of the matter? So far as positive science at present goes, Yes But man, the questioner, still remains, and Reason, true to her first impulse, still demands an explanation. Of the explanation afforded by revelation this is not the place to speak. But, quite apart from the fact of revelation, the explanation said to be revealed still stands as a product of the human mind. And he is a bold man, if not a foolish, who, having regard to the past history of human thought on the question, lightly sets aside the conception of a Caussa causturem to whom we may attribute "problectally all the higher attributes of man; not because personality, wisdom, love (the symbols we employ), can truly describe or define that which passes man's comprehension, but because being man we can no other. Man alone in the organic world is capable of ideals, and for generations the name of God has stood for man's central ideal of power and perfection And it seems to us that the sum and substance of positive criticism as applied to man's conceptions of that which admittedly lies beyond the reach of positive science comes to this. "You must frankly acknowledge and confess that such conceptions are symbolic and ideal." But if symbolic and ideal we must expect the symbolism to be variable in different ages, among different peoples, and even in different individuals. Hence (apart from revelation) the only indefensible attitude is that of inelastic dogmatism, positive or negative

In conclusion, we may say that the "Riddles of the Sphint" are in this work treated with considerable, though frequently misquided, power. The conception of evolution as a tendency towards an ideal of perfect individuals in a perfect society is good, and is in parts well worked out. That many will be found to acquiesce in the author's solutions of the old problems of hie we think exceedingly doubful. Not do we think that the solutions will prove of lasting value. It is futile to attempt to preserve the new wine of positive science in the old bottles of presistentic metaphysics. Fin new wine must be preserved in new bottles. In other words, a new interlapies insust be and is being elaborated, in special relation to the newer aspects of scientific thought.

ANALYTICAL METHODS OF AGRICULTURAL CHEMISTS

Proceedings of the Association of Official Agricultural Chemists, 1890 (Washington United States Department of Agriculture)

THIS is a Report of the Seventh Annual Convention of the Association, under the Presidentship of Mr M A Scovell, and with M1 H W Wiley as Secretary The objects of the Association are to secure uniformity and accuracy of methods, results, and modes of statements of analyses of manures, soils, cattle foods, dairy products, and other materials connected with agricultural industry, and to afford opportunity for the discussion of matters of interest to agricultural chemists. In the words of a past President, it aims at laying "a foundation so solid, that every Court in this land must respect its conclusions, and every analytical chemist, whether he lives in this country of elsewhere, must be forced either to practice or admit the advantages and correctness of our system of analyses" A study of the programme and of the proceedings shows that the objects have been most carefully and conscientiously kept in view, and that all the working members have been most thoroughly imbued with the spirit of the Association

The reports submitted for the consideration of the meetings, all drawn up by experts, and incorporating the work of many members, were as follows: on the determination of nitrogen; on analysis of dairy products; on analysis of potash; on analysis of cattle foods; on analysis of

sugar; on analysis of phosphoric acid; on analysis of fermented liquors, and a report of a Committee on foods and freding-stuffs

As an example, for the report on the determination of nitrogen in manures, three samples, containing nitrogen in different states of combination, were prepared, and sent to the members for analysis by various official methods. Twenty-two reported the results obtained by Kieldahl's method on one sample, the same number the results of Kieldahl's method modified for nitrates on two samples, and a less number gave results by the Ruffle method, the soda-hme method, and Dumas's method on one or more of the samples The whole of the results are collated, with the remarks of the analysts thereon. so that data are obtained for testing the accuracy of the methods under various conditions, and climinating personal factors Various suggestions for the improvement or simplification of the processes are made and discussed, and some of them recommended for systematic trial during next year Similar good work is done for the other Committees

The remarks of the Committee on ways and means for securing more thorough chemical study of foods and feeding-stuffs, are particularly worthy of attention, pointing out, as they do, the deficiencies in present methods of analysis, and the absolute necessity of more exact methods and more accurate study of the proximate principles contained in foods, and of their physiological value. As a contribution towards this knowledge. Mr W L Stone sends a paper on the occurrences and estimation of the pentaglucoses in feeding-stuffs, in which he shows that bodies yielding furfurol, and therefore presumably pentaglucoses, are present in grass, straw, linseed meal, and a great many other feeding-stuffs Among the points which are noticed, and which should be known to all analysts, is the fict that cotton-seed meal, often used in mixed manures in the Southern States, is completely soluble in nitric acid with a little hydrochloric acid, but that the solution does not yield all its phosphoric acid to aminonium molybdate.

Should such a Itill as that introduced by Mr. Channing, for the better prevention of the adulteration of inanires and feeding-stuffs in this country, ever become law—and the Government has promised to take up the matter—the formation of such an Association of Official Agricultural and Analytical Chemists in this country would be almost a necessity, and it is seems that the Institute of Chemistry is the proper body to arrange the organization of such an Association.

GEOLOGICAL RAMBLES ROUND ABOUT LONDON

Hand-book of the London Geological Field Class By Prof. H. G. Seeley, F.R S. (London. G Philip and Son, 1891.)

THIS little book is a record of excursions similar in some respects to those collected in the volume of Geological Excursions which was noticed in these columns on June 18 (p. 149). But there are points of difference. This hand-book deals with a more limited area, being practically restricted to the south-east of England; it has purpose more definitely cloudational. The la'ere may

be described in a few sentences extracted from the preface -

"This Society exists to teach the elements of Physical liminary study from books . . The field work has been led up to by short courses of winter lectures given in London, designed to connect together the observations to be made in the succeeding summer, and to connect the geology of the district to be examined with that of other areas

The excursions are described in the notes written by atudents in the field; the lectures are reported (from shorthand notes) by Mr. White, one of the class. As regards the former, Prof Seeley states that "students have been free to report what they saw and what they heard, and they have severally written in their own ways both as to length and language used." The lectures also "were not constructed with a view to being reported, nor were the reports written out with a view to being printed." Prof. Seeley has, however, " read the proof to remove serious inaccuracies" The lectures need no apology, for they are excellent examples of that clear and suggestive method of teaching of which Prof. Seeley is a master The reports of the excursions also acquire a certain freshness as recording the impressions of novices, and may on that account be even more helpful to beginners than if they had been written by more experienced observers. One or two maccuracies, however, appear to have escaped the Professor's watchful eye Is not the statement on p. 18, relating to the presence of Paludina and Unio in such Wealden Limestones as the Petworth Marble, a little misleading? for it implies that the latter genus is common in these deposits, which, we believe, is not the case. A sentence on p 20 suggests that "enormous pressure" is requisite to convert a sandstone into a quartzite. Very probably this would be the result, but there are not a few quartzites which show no signs of having been specially subjected to pressure. Also, it is hardly correct to call Lydian stone an altered sandstone. Again, more than once it is intimated that gness and crystalline schists occur in Belgium. This, if the terms be used in their ordinary sense, is incorrect; and even the perphyroids and amphibolites, and the abnormal rocks of the Bastogne district, the vague descriptions of which may have given rise to this misconception, are of extremely limited extent But these are very trifling blemishes, which can be readily removed in a second edition. The book will be of great use to all students. living in or about London, in helping them to use their eyes, and most of all because, to quote Prof. Seeley's words, "It here and there touches upon problems which are not usually presented to beginners." But, as he rightly urges, these problems-namely, the application of stratigraphy to the elucidation of the physical geology of past epochs "should never be absent from the mind of anyone who considers geological facts in the field " T. G B.

OUR BOOK SHELF

Katalog der Bibliothek der Deutschen Seewarte zu

NO. 1136, VOL. 44]

Hamburg, describing the building, its equipment of instruments, and the important work which is carried on there chiefly in the interests of the German Imperial and mercantile navies

As this institution is possessed of a library containing some 10,660 works, it has for some time past been a matter of urgent necessity that an accurate and wellpublished The required book was completed last year. and is now available.

This Catalogue shows that the library contains a large proportion of works either directly of a naval character or bearing upon naval matters, whilst several other branches of science are fairly represented.

As might be expected, meteorology holds the first place of importance, and amongst the 2760 works on this subject are a large proportion of Dove's writings. Indeed, it seems worthy of note that Dove's library, which occupied him many years in collecting, may now be found at the German Naval Observatory Turning to the division of the Catalogue on physics, 1617 works will be found; on magnetism and electricity, 974, whilst other subjects, such as navigation, hydrography, and construction of ships are well cared for

Although the books and papers mentioned in this Catalogue are generally printed in the language adopted by their authors, a translation into German of several works of interest is also placed side by side with the original

In conclusion it may be remarked that although there is nothing specially new in the arrangement of this book. it is well worthy of the time and energy which have evidently been spent in bringing the work to its present

Scientific Results of the Second Yarkand Mission, based when the Collections and Notes of the late Ferdinand Staticzels, 1th D—Coleoptera By H W. Bates, F.R.S. J Baseon, and F. Bates. Pp. 1-79 and 2 Plates (Calcutta: Published by order of the Government of India, 1850)

THIS, the twelfth part issued, all but one of which deal arms, me wentin part issued, all but one of which deal with zoology, contains an enumeration of 207 species of Coleoptera. These species belong to the following families: -Cicindelider (4), Carabidae (60), Longicomia (5), Phytophaga (25), Halpidae (1), Dytiscide (8), Gynnide (1), Hydrophilder (3), Staphylinidae (9), Scarabidae (38), Staphylinidae (38), Scarabidae (38), Staphylinidae (38), Scarabidae (38), Staphylinidae (38), Scarabidae (38), Staphylinidae (38), Scarabidae (38) bæidæ (38), Cetoniidæ (3), and Heteromera (50). Diagnoses or descriptions of all the new genera and species were published more than ten years ago, and the only additional information contained in this part is a list of species, in addition to, in some cases, fuller descriptions of the novelties. In the portions contributed by Mr H W Bates and Dr. Baly, both of whom, however, give some particulars regarding geo-graphical distribution, the references to the published diagnoses are given; but in Dr Sharp's and Mr. F. Bates's contributions, many of the genera and species are mentioned as new, though diagnoses of the whole of them of the Asiatic Society of Bengal, xivit Part 2 (1878), the latter in Cistula Entomologica, 11, (February 1879). The two plates include 44 figures - Carabidæ (17), Longicorma (5), and Heteromera (22) On the cover, and also on p. 37, the name "Hydrophilide" is misprinted "Hydro-ptilide" The Hydrophilide do not belong to the order Coleoptera at all, but to the Neuroptera! It is to be regretted that a delay, the cause of which is not ex-plained, of more than ten years, has occurred in the publication of the "Part" dealing with the Coleoptera, as Katatog der Bibioteks der Duttschen Seemerte zu Hamburg, (Hamburg, 1890) – Hamburg, 1800 – Ha NATURE

yet been published, and even a fragment like the present, containing a his of the species of a neighbouring reason, is a welcome addition to our knowledge. Four other "Parts" have been issued on the Insecta-the "Neuro-ptera" and "Hymenoptera" (both in 1878), and the "Lepidoptera" and "Rhynchota" (both in 1879), the last Part of the whole series being the "Araneidea" (1880).

Popular Astronomy By Sir George B Airy, K C B Seventh Edition. Revised by H H Turner, M A, B Sc (London Macmillan and Co, 1891)

ALTHOUGH our astronomical knowledge has been enormously extended since the lectures forming the basis of this well-known book were delivered (1848), Mr. Turner has not found it necessary to make any very considerable revision, for the reason that the advances have been chiefly on the chemical and physical sides Still, in the lapse of time, methods of observation have been unproved, and accounts of these find a place in Mr Turner's notes. Among these are short descriptions of the chronograph and the new "electrical controls" for the drivingclocks of equatorials One of the most noteworthy points brought out in the new edition, however, is the modern estimate of the value of observations of the transit of Venus as a means of determining the solar parallax. It was formerly supposed that this would be one of the best methods, but the difficulties encountered in 1874 and 1882 prevented observations of the necessary degree of accuracy; and now most astronomers are of opinion that this method can never give more than an approximation to the truth. Numerous minor additions have also been judiciously made

LETTERS TO THE EDITOR

[The Editor dost not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to convespond with the worster of, rejected manuscripts intended for this or any other part of NATURE No notice is taken of anonymous communications.

Force and Determinism

"THE relation between force, which is a mechanical thing, and will or life, or whatever it is, which is a psychological thing"—a relation which, as Dr Lodge rightly says, "demands investigation"—presents itself to some of us as follows

When a stimulus received by an organism gives rise to a response, however particular to the inhividual respondent, there are (1) a number of complex but determinate molecular changes in the organic issues, and (3), accompanying once of these changes, orrain psychological states. Are these psychological states produced by the molecular changes for are the so-lecular changes produced or in any way guided by the psychological changes produced or in any way guided by the psychological changes produced or in any way guided by the psychological changes produced or in any way guided by the psychological concirences. In other words, they are distinuiguabable (and the distinction is aboutle,) but not divamble.

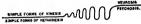
duanction is absolute), but not divisible.

"The energy displayed by a gang of navies is not theirs, but their vicinals"; they simply direct it." In physiological language it is the outcome of the proper fractioning of their meaning of their propers. In the outcome of the proper fractioning of their meaning of their propers of the propers of the propers of the outcome outcome of the outcome outcome of the outcome outc

Now to say that mind, or will, or consciousness directs the organic energy along a definite path we regard as moureed, because it ignores a distinction which we hold to be whild and valuable, and conducive to clear thinking on these difficult subjects. But we have no such objection to the statement that

the energy is guided by molecular forces which have for their subjective aspect certain states of consciousness. To unscientific folk this may sound mere quibbling; but to physicists, who have done so much to teach us the vital importance of accurate language for clear thinking, we look for support in drawing this distinction, unless the distinction can be shown to be either myall of unless.

The datunction between force, energy, and the physical sense (what I have elsewhere spoken of as kensar) on the one hand, and thought, consacousnes, and the psychoial sense (what I have elsewhere spoken of as smallener) on the other hand, we have elsewhere spoken of as smallener) on the other hand, we have elsewhere spoken of as medicaries) on the hand, we have elsewhere spoken of the other hand, we have elsewhere the hand of the hand



Now, looked at from above, the wriging or supposed to reprevan the development, from winth, for wor and under store, of that complete form of kineses which we cull nearness. From this point of view, all is force and energy or kineses, and cun become nothing clie. Looked at from below, we have the development of connectioners. From what? We must not say jumping across the line, or, in other words, ignoring the disniction. From what, then? From those lower forms of "something which-is notypi-connecistories but which may-determ metakiness."

I have elsewhere endeavoured to show that this view is not open to the objection that, were the kinetic sequence in a continuous and determinate one, consciousness is merely a lypoulous, and that an annoneuson. Diversin might have written product, and that an annoneuson. Diversin might have written consciousness, though it is distinguishable from, it is according to enhypothesis, no less inseparable from, certain complex modes of the kinetic process. As the world it constituted, such of the kinetic process. As the world it constituted, such of the kinetic process. As the world it constituted, such of the kinetic process. As the world it constituted, such of the kinetic process. As the world it constituted, such of the kinetic process. As the world it constituted, such of the kinetic process. As the world it constituted, such of the kinetic process in the world in the kinetic process. The world is the kinetic process. The world is the kinetic process and the world in the world of living beings of the world of living being of the w

not be the same kineses but something allogether different. In other words, it is with cert am molecular transactions which have the or a constitute of the constitute of the

Law afraid that, as Prof. Lodge has accepted my "middle principals" accessly, he has failed to appreciate its point. For, if that paragraph is correct, the Professor's ascetton, "Force is certainly necessary to direct the motion of matter," is only a truum, similar to the important geometrical theorem, "In any right angled triangle, one angle is equal to 90". On the other hand, Dr. Croil's assertion, to the effect that guidance is effected the service of the professor of the pr

must have some independent definition of "force," and a issould very much like to know what that wewers "the cause in my last paragraph." Fred. Lloyd Morgan implies in his last letter that, in the case of the san altering the direction of motion of the earth, no energy is expended. This is, of course, only spgrounnetly true; and eren in the case of his twithing his stick round his finger and thumb, as the stick is elastic, its forces of contents. It was also that the stick is elastic, its forces of contents are considered in the stick is the stick is the stick is expensed by the stick is the stick is the stick is the stick is expensed by the stick is the stick is the stick is the stick is expensed by the stick is the stick is the stick is the stick is used to the stick is used to the stick is not all the stick is the stick

a string into action, it would be necessary to wait till two particles were moving on paths with a common normal—an occur-rence which must be infinitely rare. When Prof. Lodge says "an infinite mass can absorb any amount of momentum, with-out receiving a trace of energy, &c.," he forgets that the term "infinite" is only relative, "an infinite mass" being one whose "infinite" is only relative, "an infinite mass" being one whose change of velocity (or kinetic energy) consequent on a given change of momentum is negligible for the furfour in hand. It would not, I imagine, suit Prof. Lodge's purpose to suppose psychic forces might do a little work, so long as it was only a

payenic onces man the cold paradox, "What would happen if an irresultile force were brought to bear against an immov-EDWARD T. DIXON.

12 Barkston Mansions, South Kensington, July 24.

THE discussion on this topic has gained in clearness by Prof. Lodge's conceding that "the same question—What determines the direction of the transfer of energy?—may doubtless be asked in connection with inanimate activity,... but in neither case do I know the answer."

Perhaps some more precision may be attained by expressing the question in other words.

The principle of conservation of energy reigns over the

quantitative relations of all processes in nature, but it does not give any explanation of the qualitative changes of those processes. These changes and their conditions must in every case be found out by special experience. But, nevertheless, they are, in every accessible case, found to be subjected to fixed laws A given substance undergoes evaporation or chemical transformation-dependent on or necessarily bound up with changes of heat late energy of molecular motion, or into chemical energy, or wise verifical and a distinct degree of temperature, or under distinct conditions of electrical action. Inaphicable as these transformations of quality or form of energy remain for as, there is nothing undetermined in them, nother have we any right to such a supposition for the qualitative changes going on

right to such a supposition for the qualitative changes going on in plants and animals—their quantitative relations being like-wise governed by the principle of conservation of energy But there is another phase of the question Some unknown material changes in the brain are connected with phenomena of consciousness. Nothing can be more fallacious than to consider consciousness. Nothing can be more infracious than to consider consciousness as a form of energy, and to suppose it in a relation of equivalence to such forms. How it is, that what to our physical conception, or outer sense, are processes in the brain (which, as such, may be more clearly understood in future), are, (winch, as such, may be more clearly undicastood in future), are, at the anne time, to our psychood sonception, or inner sense, phenomena of consciounness, or acts of will, is a question beyond the domain of physical senerce, and capable of elisudation only by transcendental philosophy Whoever wishes for mote high there, must study the "Kritt der reane Peruntifi," especially the chapters "Von den Paralogismen" and "Die Autonomier." Antinomien,

Schopenhauer, and others after him, have considered our Schopenhauer, and others are filling have Considered that power of will, or our conscious directing of motion, as the key for all qualitative processes in nature, these being considered as, in their essence, acts of will. But this is cutting the knot by means of a metaphysical assumption

D. WETLERHAN, Freiburg, Badenia, July 27.

In reading over the remarks of Dr. Lodge and Prof Morgan upon Dr. Croll's views as to the direction of force, it appears to me that both have missed the point. Dr. Croll did not mean that a force at right angles to mother the two work, but simply more than a force Dr. Lodge says it is, although the exhowledges that the second force does no work. Further, Dr. Croll says, with regard to the find force, that is direction is crolled to the crolled specific the force of the crolledge states the second force does no work. Further, Dr. Croll says, with regard to the find force, that its direction is a first than the crodial paint before we get to a second force or to a right angle. I, fulfy acknowledge the importance of Dr. Lodge's pranciple, but it is not unply the indorsement of Prof Morgan thinks Dr. Croll's view no assumes a feet.

Prof Morgan thinks Dr. Croll's view no argument in favour theism. It does not prove that mind can or does affect of theism. matter Perhaps it does not directly prove this, but, within its range, it seems to me an effective reply to mechanical atheism. We see direction, and if this does not come from force it must come from some other source. We know of no other source but mind. To talk of mind affecting matter denies the essence of mind by which it is distinct from matter, and makes it a mechanical ab extra But try to banish it and it will come in

mechanical ab extra But try to bannan it and it was come in somewhere. "Tamen usque recurrer"

Dr. Croll's position seems to me to affect the first law of motion Uniform motion in a straight line is in no way comnected essentially with force, if his view is correct

Dr Lodge's principle appears to affect the second law of motion, and also the doctrine of impact and transference of force.

Further, it affects gravity. Gravity is always at right angles to the first law of motion, and therefore gravity is not a force; for that can not be a force which never exercises force.

T. TRAVERS SHERLOCK.
Congregational Church, Smethwick, July 25

Technical Education for Farmers, Farriers, and Engine-Drivers

KNOWING that you take very great interest in the various questions relating to technical education, I may give you a few particulars of an experiment which the Devon County Agriparticulars of an experiment which the Devon County Agri-cultural Society recently muled at its Exmouth meeting. Being desirous of giving farmer-, farmers, and those generally interested in the welfare of horses, some information on the scientific prin-ciples which underthe proper performance of the duties of the farmer, and the correct form and mote of attachment of horses' shoes, and also of giving farmers and engine-drivers some practical and scientific instructions on the working and care of practical and scientific instancious of the working and calculations are steam-engines, the boxiety approached the County Council with a view to a grant in nid of their object. The proposal was very a view to a grant in mot of their origins. The proposal was very warmly taken up by Mr. Lethbridge and office gentlemen who are well known for their active inferest in education and other matters important to the welfare of the county, and a grant was obtained

The Society secured the services of Prof F Smith, head of the Army Veterinary School, Aldershot, and of Mr. W. Worby the Army Veternary School, Adderstoit, and of air w. wordy Beaumont, and by these gentlemen lectures were given on each of the three days of the Society's meeting at Exmouth The weather was very unfavourable on two days, but notwithstanding this the attendance at the lectures was large, and on the second and third days was larger than was expected, and was fully up to the accommodation provided. The audiences were remarkably attentive and appreciative, and in every respect the experiment proved successful. Many who were sceptical before the lectures of their value to working men, became convinced that not only is it possible to give working men information which is useful in is it possible to give working men information which is useful in an iniportant degree in their daily work, but that the inen are themselves quick to appreciate its value. I may mention that on one of the days nearly two hundled shoeing smiths and a large number of farmers attended the horse shoeing lectures, and on one day seventy-eight engine drivers entered for the lecture on the steam-engine, and there were also in attendance a

Totacs, July 20 John JOHN L. WINTER.

THE ERUPTION OF VESUVIUS OF JUNE 7.

THE suggestion that I published in several newspapers has been fully confirmed-namely, that the second alternative type of eruptive character would be pursued by the volcano Now for a period of over a month lava has continued to dribble forth, activity has returned to the central vent, and no great changes have occurred

The throat of the volcano commenced to be cleared on June 9, the vapour forcing its way up from the crater bottom through the choke of loose materials, and rose above as a column carrying with it much dust; at the same time the powerful vapour blast issuing from the upper extremity of the lateral rift, of which mention is made in my first letter, soon stopped Each day I was kept informed of the state of the volcano by the kindness of Messrs Ferber and Treiber, the director and engineer respectively of the Vesuvian Railway
On June 15 I considered it right to again visit the

mountain, and had the good fortune to be accompanied by Messra. H. Elliot, A. Green, Landen, Newstead, and Treiber, several of whom are excellent photographers, so that with two of my own cameras we were able to make an extensive pictorial record of some very unique

At the point of issue of the lava, at the junction of the foot of the great Vesivian cone and the Airio del Cavallo, the first lava had cooled sufficiently to walk over it, but beneath our feet could stull be seen in a few holes the dowing lava. At the foot of the great cone, and of the great cone, and of the erupture ent, as if this had continued so far, were a series of driblet cone fumaroles. We counted seven complete and well-formed casamples, besides numerous aborture ones. Most were giving out intensely heated beneath, and which soon carbonized a piece of wood placed in it. Around the lips of the upper opening, hematite with fused chlorides of potash, soda, iron, if

of scoria from the vapour that otherwise would escape after its exit Leucite I have also demonstrated to be formed while the magma is simmering under low pressure with free escape for vapour in the upper part of the volcanic chimney 1.

At the summatof the great cone the crumbling in of the edges was constantly going on, but the upper extremity of the lateral rift at the fost of the cone of eruption and at the summit of the great Vesuvian cone had nearly cassed to give forth vapour. Along the line of rent on the mountain side no financiole or other signs of activity were visible except quite at the foot, where those commence of which have souked.

Up till June 20 there was a struggle to clear the upper part of the volcanic chimney of the impeding materials, which were constantly being added to by the slips from the cratter's edge, but on that evening a dull red glow was visible in the cratter bottom, showing that a fairly clear passage had been temporarily made for the continuous escape of vapour, and also that the lava was at no very



copper, &c., were being condensed from the vapour, and trickling down the outer surface of the fumarole, consolidated as curious vari-coloured stalactites of very deliquescent nature.

The lava had first flowed towards the escarpment of Monte Somma in a fan-like manner, so that the eastern extremity reached that great natural section just beneath the Punta del Nasone. Still following the natural inclination of the ground, it turned to the west, and on june 15 was opposite dyke 16 (as marked on my large geological map just published, and on the dykes themselves), advancing at a very slow rate.

The lava is a virrous and coarse-grained rock, especially in regard to the included leucite crystals, whils it is surface is, with one exceptional tongue, of the corded or "pahoehoe" type. This is due to the magma being one that has been simmering since January in the chimney of the volcano, so that most of its dissolved H₂O has been boiled off, and so allowing it to cool without the formation

great depth from the summit of the volcano. This of course indicates that the lateral opening was in-sufficient to drain off much of the larva which occupies the chimney above the level of the lateral outlet. Had such executation really taken place, the eruption would amount of lava above the rap, but more from frothing up of that below that level in consequence of the relief of pressure that in that case would occur of (course, during all these days the ejection of dust with the smoke occurred, guying the latter that peculiar dark grey colour occurred, upon the latter that the case or city could place, so as to partly block the outlet, and it was not till our next visit that it again clearly, and it was not till our next visit that it again clearly.

On June 30 I again visited the crater, in company of my friend Mr A. Green All the summit of the great cone

"See H J J L "Geol M Somma and Vesuvius," Q J G S, vol xl and "Relationship of the Structure of Ign our Kecks to the Conditions of their Formation," Second Proceed R Publin Soc, vol v, N S was covered by a thick coating of dust and sand, upon the surface of which were the usual white and yellowishgreen chloride crusts seen on such occasions, so rich in coper as to plate with that metal the iron nails of our boots. The crater had considerably enlarged, the edges were in the compared to the compared that, with a slight push by a stick, it was possible to detach large masses of the materials which form the sides of the crater in the recent cone of eruption. So danger-cons were the edges, that it was but in two places that my experience indicated as being safe to approach and look over, and that even with several precautions; so that the here but a few hours after our departure, is not to be wondered at.

On looking down some 45 to 50 m beneath us, we could see the glow from a mouth some 2 or 3 m. in diameter. The walls of the crater were concave, so that athough overhanging at the top, yet a plumble included the crater bottom was roughly plain, due to the combination of a talus all round, and an attempt at a cone encurling the main vent. It will be thus seen that the crater cavity was of the form of a convex-sided cylinder, or more simply was of the form of a convex-sided cylinder, or more simply

barrel-shaped, with its upper diameter some 50 to 55 m.
With much difficulty we made our way around to the north side of the cone of eruption, which had now lost its usual loose scoria surface, which was buried beneath a thick coat of sand and dust, covered with a thin saline crust on its surface The upper limit of the radial rift, which we were prevented from examining three weeks previously, on account of its giving out so much vapour as to constitute the temporary escape aperture of the volcano, had now become quiescent, so that we could fully examine it. Only a current of hot air was now issuing from it, but I was able to collect some fine masses of crystallized molysue and kremersite from its edges. Its average breadth was about 0 50 m, where it traversed old compict lava, but of course it disappeared as soon as it reached the looser materials. The real azimuth of its orientation, which we could now determine with greater accuracy than when we were walking over hot rock and enveloped in hot irritating vapours, proves to be, as it radiates away from the axis of Vesuvius, about 15° west of north. It curves then a little to the north, and near the foot of the great cone it again assumes nearly the same azimuth as at starting, an arrangement which is quite evident when the Vesuvian cone is regarded from the Punta del Nasone From that, the highest point of Somma, the lower extremity of the rift lies a little to the right or west, and faces that part of the Somma ridge which corresponds to the upper extremity of the Vallone Cancherone

In the forenoon of June 30 much dust had fallen at the lower railway station, of which we collected some bagsful. It is the usual fine sandy material of these eruptions, and consists of the pulverized materials of the cone of eruption.

Having passed the night at the lower railway station, the next day we crossed the Artin, ascended to the western extremity of the ridge of Somma, and followed it along so as to get a general burd's-eye trew of the whole scene of the eruption, and take photographs of the more important points. As one stands on the Purta del Nissone and embraces that magnificent view of Vesuvius and the Artin old Cavallo, one sees at their feet the new to the control of the ridge we found a thin coating of the ridge we found a thin coating of fine red dust which had reached thus far from the crater. Much of the Artino was also covered by the same material. Scaling the chiff face just beyond the Cognillo

di Ottajano to the Atrio del Cavallo, we again visited the lower point of the outburst. Most of the beautiful fumaroles were in a state of ruin, and lined by good-sized crystals of hematice and mixed chloride criests. Here the lava was quite solid, though at one point was a hole, some 50 m. from the base of the great cone, where we could see the molten rock flowing lazily along about a metre beneath our feet. The lava at the end of the flow was making considerable progress to the westwards, and stood outboatt divke 13.

and stood opposite dyke 13
Since then, few changes have taken place in the mountain: the crater still gets larger, dust is thrown out, and the lava descends. These phenomena are capable of continuing for months if the drainage opening does not

As the eruption progresses, I will send you further details.

H J JOHNSTON-LAVIS.

THE PRODUCTION OF MUSICAL NOTES FROM NON-MUSICAL SANDS

THAT I have succeeded in producing musical notes from sand that was never before musical, and am also able toproduce similar results from certain mute or "killed" musical sands which have been temporarily deprived of their musical properties, has already been announced in the Chemical Wexty (vol. buy No. 1620).

It is not necessary now to gwe the details of the miserous experiments which led up to this discovery; it will be, perhaps, sufficient for present purpose, it will be, perhaps, sufficient for present purpose, which is propounded a theory to account for the cause of musical sounds issuing from certain sands. After giving avrous reasons for my conclusions, I said—"I to occurred to me, then, that the music from sand was simply the operation of the prefectly default and the proposed of the perfectly default given from the proposed of the pr

Having described numerous experiments, and drawn attention to the hopeful results obtained from the "millet-seed" sand, my paper concluded with the following.—
"From what I have now told you, I think we may conclude that music may be produced from sand if (i) the grains are rounded, polished, and free from fine fragments; (2) if they have a sufficient amount of 'play' to grains are perfectly clean, and (d) if they possess a certain degree of uniformity in size, and are within a certain range of size."

On June 20 last I visited Studiand Bay for the purpose of carrying out some new experiments. I found that the musical patch emitted tones louder and more pronounced than I had ever heard them there before. The best resulting the properties of the sand; sounds produced in this way were heard unmistakably for a considerable distance. The patch wareaged 7/2 yards in width, and ran parallel with the trend of the shore for some hundreds of yards. The trend of the shore for some hundreds of yards. The notes of a high purch; that on the land find evan coatte, and emitted notes of a lower pitch. The rod drawn across the patch gave, therefore, a great variety of pitch. Many other interesting facts cannot now be referred to, but it is important to state that some of referred to, but it is important to state that some of some patch. The rod drawn of the patch of

1 Read before the Bournemouth Society of Natural Science

notes of a low pitch, but the fine was mite. This was, so far as I know, the first time that the Studland

sand had been musical of the patch.

According to my theory, if the number of grains with polished surfaces could be increased in this fine sand, the number of vibrations would increase also, and so intensify the note, and cause it to become audible, this could only be done, however, by introducing a certain percentage of grains fulfilling the required conditions. To obtain such grains and to introduce them gradually until the necessary number should have been added. would have been a tedious process; and it occurred to me then that the same result might be obtained if the sand were struck in a vessel with a hard and polished interior I placed, therefore, this fine sand in a teacup, and on striking it, found that it emitted a high, shrill note (A in altissimo), which was far more intense than that given when it formed a part of the patch.

When polished grains of sand are in contact with the sides and bottom of a glazed porcelain vessel, it is obvious that there are numerous points of contact between two polished surfaces-the sand grains and the vessel-and that on striking the surface of the sand, the friction necessary to produce the vibrations of a musical note is

induced between these points

This I proved by placing the same sand in various vessels with rough interiors, and by lining these glazed or polished vessels with silk, &c, but in no case would this sand emit notes unless the grains were in direct contact with the glazed or polished surfaces This pecuharity is not in any way dependent upon the sonorous properties of the vessel used, for it may be "deadened" with impunity, and the note will remain unaltered

The results of numerous experiments show that musical sand of the Eigg type—ie sand possessing in great per-fection the physical conditions necessary for the produc-tion of music—will be musical in receptacles of whatever composition or form, though in some of these it emits notes "under protest" only 1

Those sands which are of the Studland Bay typehaving the necessary physical conditions less perfectly developed, and are usually mute except in situ-will emit music only in vessels possessing hard and glazed interiors. and, as a rule, of a certain form, while some of the more "sulky" types of sand not only need a vessel of hard and glazed interior, and definite form, but also require a box, or small pedestal of wood (which I call a "coaxer"), on which this vessel must stand before the notes emitted become audible A "sulky" sand was rendered far more musical by being sifted, washed, and boiled, giving out, after this treatment, notes without the aid of the coaxer."

After discovering what could be done with such simple apparatus, it occurred to me to try, under similar conditions, some of my abandoned sands-those unmusical sands that had been, during a period of four or five years,

treated unsuccessfully for music

One sand (an iron-sand composed of more or less polished grains, quartz, and much dust formed of denser minerals) gave a very hopeful "swish" (explained in my paper of 1888) in a certain porcelain vessel, and from this-by (1) sifting in sieves, to eliminate the fine material, and to insure uniformity in size of grain; (2) rolling down an inclined plane of frosted glass, to separate the rounded grains from the angular quartz, and (3) boiling in dilute hydrochloric acid, to cleanse the surfaces—I succeeded in producing a sand that, in certain glazed vessels, emits musical notes as clear as those emitted from any of my

NO. 1136, VOL. 44]

musical sands but that of Eigg This sand gives Fin allussimo, but it very soon becomes "killed" because of the fine dust and loss of polish that is the inevitable result of the attrition of the grains. There remains but one thing to be done, and that is to produce a sand which, like that of Eigg, will be musical in almost any receptacle, and I have reason now to think that this will not be very difficult

It has not been possible here to record more than the merest outline of what has been done, or to give instances of the interesting capriciousness of these sands: it should be understood, however, that no ordinary beach or cliff sand has the slightest inclination to "sing" under any of the "coaxing" methods at present known to me

CECIL CARUS-WILSON.

NOTES

SIR MICHAEL HICKS BEACH, who previously gave a negative answer to the request made by the Executive Committee of the British Institute of Preventive Medicine, having reconsidered his decision, has now granted the required license to register the Institution as a Limited Liability Company, with the omission of the word "Limited" The license, however, is not to be construed as expressing approval by the President of the Board of Trade of experiments on animals, or in any way affecting the exercise by the Secretary of State of his discretionary powers to grant a vivisection license to the proposed Institute The articles of association have been signed, and the Institute is now duly registered. The following gentlemen have already expressed their willingness to serve on the Council Sir Joseph I ister, Chairman, Sir Charles A. Cameron, Mr. Watson Cheyne, Prof Michael Foster, Prof Greenfield, Prof. Victor Horsley, Sir William Robeits, Sir Henry Roscoe, Prof. Roy, Prof. Burdon-Sanderson, Dr. Pve-Smith Dr. Armand Ruffer, of 19 Iddesleigh Mansions, Westminster, SW, will act as honorary secretary until the first meeting of the Council.

THE graduation ceremony at the close of the summer session of the University of Edinburgh was held on Monday. Principal Sir William Muir, Vice-Chancellor, presided. Prof Kirkpatrick presented for the honorary degree of Doctor of Laws Colonel Sir Colin Campbell Scott Monerieff, K. C.M.G., C.S. I. R E., remarking that, through his work as chief officer of the irrigation works of the Nile, it could be said that Sir Colin had created a greater and an infinitely freer, happier, and more prosperous Egypt than it was before As a gallant officer, a distinguished man of science, a statesman of high merit, and, above all, as a benefactor of his fellow-creatures, Sir Colin was pre emmently worthy of the highest of their academic honours. The honorary degree of Doctor of Law was then conferred in abuntal on Prof. Simon Newcomb, Washington

SIR JOSEPH FAYRER has been elected a Corresponding Mcmber of the Royal Italian Society of Hygiene Sir Joseph has also been promoted from the grade of Foreign Corresponding Member to that of Foreign Associate of the French Academy of Madicine

PROF. DU BOIS REYMOND, the distinguished physiologist of Berlin, has been awarded the Gold Medal for Science.

MR. J. E KEELER has been elected Professor of Astrophysics in the Western University of Pennsylvania, and Director of the Allegheny Observatory Mr F W Very is associated with him as Adjunct Professor of Astronomy. It is expected that the Observatory will continue its researches on important problems in the domain of asiro-physics.

IT is stated that Slam, following the example of Japan, is commencing to Europeanize her institutions. The founding of

[&]quot;When muscal rand, count "under protes" they give out high, shrift become in a thinbleful of the Eigs and. "Small quantities east not easily a pick high pick high protest and are quickly "whilet" by constant strings. By an-the harder muscals present abrade the softer as they rub bayerber, and this forms a fine date.

a University has been decided upon, and Prof. Hasse, of Konigsberg (Germany), has accepted the appointment to the Chair of Physics.

THE last number of the Rendsconts of the Reale Accademia del Lincel contains an account of the annual meeting held on June 9, at which the King of Italy was present. After the opening speech of the President, Brioschi, one of the chief features was an admirable address by Prof. Measedagkin on the Homeric urangloocy, with speech reference to precession.

La Revue Scientifique of the 1st instant contains the address by M. Villemin, the Piesident of the Tuberculosis Congress, It deals with recent researches. The results of the first Congress are also detailed by M. Petit, the General Secretary.

A FIRAL meeting of the Committee of the Virchow Testimonal Fund took place on Joly (5, 5r James Fage, Bar 1, F.R.S.) in the chair. The Treasurer gave an account of the moneys received, which amounted to about 4.75 ft was resolved to send this sum to the General Treasurer of the Fund, and to preem For Virchow on the occasion of the hardsday with an illuminated sideres, conveying to him the congentualtions of the Committee and subscriber. This the Honosary Secretaines, Dr. Semon and Mr. Hotsley, were directed personally to transmit to Berlin on the occasion of the Celebration

This Essex County Council has appointed an Organizing Jonn Committee, constaint of air members of their own body and six members of the Two my body and six members of the Essex Field Liab, to form a centre for employing lectures and teaches; both apparatus and maternals), conducting examinations, and affording help and guidance to local bodies, in connection with the recent grants towards technical instruction. A grant of 2900 has been made for these purposes. The members of the Committee are (representing the County Council) Mr. is. N Buxton, Mr. F. A Fitch, Mr. B. Whittingham, (for the Fixes Feeld Crub) Prof. Londger, Mr. F. Chancellor, Frof. R Meldola, F.R. S., Sur Henry F. Roscow, M.P., F.R.S., Mr. F. W Kudler, and Mr. J. C. Shentione. The Organizing Secretary to the Committee is Mr. W. Cole, 35 New Broad Street, L.C.

THE idea of "a British Museum of Portraits," to be executed by photography, was conceived as long ago as 1864 by Mr. James Glausher, F R 5, and brought before a meeting of the Council of the Amateur Photographic Association, of which the Prince of Wales is the President The suggestion was cordially approved by the meeting, and photographs were taken in carte de visite size and deposited at the South Kensington Museum, At first, however, only fading silver prints were made, and these were so unsatisfactory that for some years the undertaking was held in abeyance By the discovery and perfection of the process of permanent carbon printing, an opportunity has at length been afforded of resuming the prosecution of the work under infinitely more favourable conditions, and, as a result, a collection of excellent portraits is now being made by the Amateur Photographic Association Already there are nearly 200 large permanent carbon portraits deposited in the Art Department at the South Kensington Muscum, and about as many more are ready to be sent. These latter were on exhibition at a private view on Saturday last at 58 Pall Mall, S W., the studio of Mr Arthur J. Melhuish (Photographer Royal) They embrace some photographs of men of distinction in science, and are excellent both as likenesses and as specimens of photographic art The conditions under which they are taken are, in fact, sufficiently exacting to insure the production of a faithful portrait, inasmuch as every portrait must be approved by the sitter and by the Standing Committee previous to its being placed in the South Kensington Museum. The undertaking is on a non-commercial basis, the photographs being taken for the purposes of this collection only, and not for publication, and no expense of any kind being meurred by the sitter. The invitations to sitters are usued under the authority of the Council.

That Trustees of the Indian Museum, Calentis, have just sende the second and concluding portion of a Casicogue of the specimens of Mammals contained in that Institution. The first volume of the Catalogue, complete by Dr. John Anderson, the late Supernstendent, was published in 1881. The present volume, which commences with the Rodentis, has been prepared by Mr. W. I. Scaler, the present Deputy-Superintendent. The total number of specimens of Mammals contained in the Indian Museum, as is shown in the Catalogue, w 4872. These are referred to 500 species, of which, 276 are found within the limits of the Indian Empire, and the remainder are from either the Catalogue, and the Catalogue of the Catalogue will be of much use to students of the cours of Mammals.

FOR the first time for many years the Journal fur Ornithologia has actually appeared within the month imprinted on the cover bearing the date of publication. English ornithologists have this year received in July the Heft bearing the date 'Iuli, 1801' Gott see dank. The articles published in the present year appear also to be of a higher class than many of those formerly round in the Journal, and some very important papers by Dr Reichenow, Dr A. B Meyer, Herren Schalow, Hartert, &c . have been published. The chief interest centres round the collections which that greatest of modern naturalist explorers, Emin Pacha, has sent to Beslin, and the birds obtained by him during his journey from Bagamoyo to Lake Tanganyika are fully described by Dr. Reichenow The novelties are not many, but are sufficient to show that there is much to be done in German hast Africa before our knowledge of its ornithology approaches completion English naturalists will await with engerness the 70 slogical work of our Consul in Mazambique, Mr H II Johnston, C B, for the whole of the district in his sphere of influence is practically unexplored as far as natural history is concerned, and at present our knowledge is almost a blank To Mr Johnston and his companions, therefore, English zoologists are now looking for information which shall connect the work of Bohm and Emin with that of Kirk and Livingstone

IN a recent paper to the Soutif des Ingénieura Civils, M. Habitumans stave, that in London the cost of the electric "bone hour" in 0.375 france, that is three times the cost of gas I to Perrais its 0.90 france, and at Saunt Beneue, the towas where, results it to 90 france, and at Saunt Beneue, the towas where, sauce June 1 law, it is cheaper in France, it is still 0.54 france, and o 10 frances for a comamption over 20 horse-power. Such difference, he point out, do not are from difference in cost of ordinates of the first part of

IT is stated that a memorial is about to be presented to the United States Congress asking for the creation of a Government Department of Public Health, with a Cabinet officer at its head, to be known as the Medical Secretary of Public Health

The Danah Academy of Scences has recently offered the following among other prise — A gold medil, worth about £17, for an exposition of the theory of electric whrations in immed and resting boldes in general, with a special application to simple forms of perfect conductors, so that for these cases, the mathematical problem may be explained, and if possible solved. A prize of about £2z, for an investigation showing in the case of our four principal cereals, the nature, and as far as possible the proportional quantities, of the chief carbohydrates for different stages of ripeness. Memoirs to be accompanied with preparations. A prize of about (27 for a complete account, accompanied with preparations, of the Phytoplacidia found in Denmark, and a monographic exposition of the species of the genus Phytoptus (in its old and wider sense), which inhabit the various galls, found on a particular plant, with the view especially of showing whether several usually different galls of the same plant species arise from the same Phytoplus in different phases of its development. In choosing a plant, preference should be given for one in which these galls have an economic value, as is the case, eg, with some occurring on the beech Further, the Academy desires an exposition, as complete as possible, of the development of a particular species of Phytoplus. The date for the first is October 31, 1892 , for the two others October 31, 1893 Memoirs may be written in Danish, Swedish, English, German, French, or Latin

The furtheh Jahonowsky Gesellichaft, recognizing the fact that the determination of the secular perturbations of the orbits of the interior planets, in the form in which they have been felt by Le Verrier, are not satisfactors, and that probably the anomaly in the motion of the perhelion of Mercury is to be explained by the fact that the differential equations have been treated interzally, offers a prize of 1000 marks for a new determination of the exist of Mercury, Venns, the Earth, and Mars, in which the terms of a higher order are taken into account Competition, are to send in the results of their interactions before November 1894, observing the usual rules to secure the annoyment of their papers.

THE Educational Times states that the Supreme Council of Hygenes of Austra has been engaged in discussing the advantages of erect as compared with slanting writing, and the official Report of Drs von Resis and Lorens points strongly in favour of the former. They point out that the direction of the written characters has a marked influence on the position of the body. In "straight" writing the scholar faces his work, and is spared the twist of the body and neck, which is a laway observable in those who write slantines, and one common cause of spinal curvature is this obstanted. The erect method is, therefore, expressly recommended for use in schools, in preference to the ordinary sloping lines.

WE have received the eighteenth Annual Report of the Geological and Natural History Survey of Minnesota I: consists of a summary statement for 1889, report of field observations made in 1888 and 1889, by N If Winnchell, American opinion on the older rocks, by A Winnchell, additions to the library of the Survey since 1884, and a list of publications of the Survey.

L'Électurit points out that the new electric photosphore, which consuss of a small glow lamp at the end of an elastic tube used for throwing a strong light for surgical purposes into the mosth, ear, &c., was really suggested by the action of the water jet in the luminous fountians now so common, and that these really owe their origin to a laboratory experiment by M. Becquerel in 1896.

HERK KENYZ, we learn from a German source, has been making inquiry into the digestibility of different kinds of cheese. The most easily digested, he found, were Cheshire and Roquefor; while others are ranked as follows, in ascending order of difficult digestion. "Emmenthal, Goognousle, Neuchkiel, Ramadour, Rotenburg, Mann, fromage de Brie, and (most indigestible of all) Swiss cheese.

In recent numbers of the American Journal of Science (February 1891) and Ciel et Terre (July 1 and 16, 1891) attention is drawn to the remarkable conclusions arrived at by Dr.

Brutker in his work entitled "Klimaschwankungen"—the most complete work extent upon the question of the variation for climate—in which he shows that the climate has not undergone any continuous waration from the easiest hatonic time, but that it oscillates, and presents alternately periods of heat and odd, and of dryness and humstlity, the period being about 35 years, which, it will be observed, as multiple of the period of frequency of varianging the control of the period of sequency of varianging the tits of years. When the period of frequency to variate the control of the period o

PART 34 of Cassell's "New Popular Educator" has just been issued, and contains articles on applied mechanics, algebra, botany, electricity, and comparative anatomy

MR G. C. HOFFMANN, of the Geological and Natural History Survey of Canada, has made a microscopical and chemical examination of a peculiar form of metallic iron found on St. Joseph Island, Lake Iluron It appeared in the form of spherules disseminated through a thin deposit of dark reddishbrown limonite which coated certain faces of some surface specimens of quartz. These metallic looking spherules were found to consist of nuclei of silicon conted with a humus like substance, which in turn was overlain by a metallic layer containing all the elements most frequently met with in meteoric But the small proportion of nickel present to 11 per cent), and the relatively large amount of phosphorus (1 o7 per cent), as also the fact that the subcrules contain nuclei appuently of a concrete character, leads Mr. Hoffmann to suggest the possibility of a terrestrial source for the material, upon the assumption that it has resulted from the reduction of an iron salt by organic matter. The paper, which is accompanied by four coloured plates, appears in the Transactions of the Royal Society of Canada, 1890

life preliminary results of some investigations upon the growth of the face are stated by Prof G M West in Science for July 3. The values obtained in the case of measurements of the female face point to the existence of three distinct periods of growth, the first ending at about the seventh year, and the third beginning at about the age of fifteen. The abrupt transition from one period to the next is indicated by the very slow growth of some children until the ages of eight or fourteen, when a rapid development often occurs. From the fifth to the tenth year the average growth appears to be about 65 mm During the next four years it is 6 2 mm, and from this time little advance is made, the maximum of 128 mm being reached at about the age of twenty I he male fact is larger than the female face at all ages Its growth is also more rapid, and continues later in life. The measurements have been on 2500 persons, including both sexes

PROF TITO MARIINI, of Venice, contributes to the issue of the Rivista Scientifico Industriale for the end of June, the results of some experiments on the crystallization of thin liquid films He finds that a strong solution of sodium sulphate, when cooled to near its saturation point, possesses a viscous character which enables it to form a thin film on a metallic ring, as in Mr Boys's experiments with soap bubbles On rapid evaporation such a film crystallizes to an extremely beautiful open jattice-work of minute crystals, which preserve their transparency for some time, and then effloresce and crumble to powder The experiments succeeded with rings up to thirty-six millimetres diameter Similar experiments with ainmonium chloride and sodium hyposulphite have hitherto proved unsuccessful. With a transparent film of liquid sulphur, however, even more beautiful results have been obtained. The author regards such experiments, besides being eminently suitable for lecture demonstration, as likely to throw light on the nature of molecular arrangement in relation to crystallization

THE same number of the Kiterica unmarates a somewhat important communication to the Naples Royal Academy of Physical and Mathematical Sciences, in which Prof Dino Publication and the situation of the American Communication of the Janac of oscillation of Foucault's pendulum in relation to the earth's rotation in lumificent. The author contends that the problem for latitudes between the pole and equator is more cannot be solved by the principle of inertia. He proposes an equation derived from the principle of composition of the rotational forces.

A METEROLOGICAL Journal in the Ressum language, the Meterological-keith, Witthin & Menesneger, has lately appeared under the competent editorship of Weelloof, Rykauschew, and Spender, ris general prias seems to be like that of the German Zentzhrift. The idea of statting it across at a meeting of the Russian Naturshits and Physicians at St. Peterships in the end of 1859. Four graphic tables are given in this journal, showing the course of the meteorological elements during 1859 at the agreedural experimental station of Sapolje, also measurements of ground temperature, &c.

THE Schlowe Scraty's Magnatus for July contains the first of series of articles on the Kew Museum by Mr. J. R. Jackson; others on the effects of neuronment on plants, and other increasing matter. Among the correspondence are complaints from Warnetchine that the Wild Birds Preservation Act is added letter there, as the "studentime," whoever they may be, take no trouble in the matter. On the other hand, the inhabitant of Schlanda set fully after to it.

THE last volume (axin, 6) of the Trudy of the Society of Manualists of Kann constains the second part of Mr. Korrchinsky valuable retearches into the nonthern limits of the black-earth seppe region of East Russis. In the first partipublished in 1885, the author gave the results of his explorations in the province of Kann. He now confirms his conclusions by further exploration in Samara, Simbirsk, Pern, and Ufa. He are given the northern limits of the black earth steppe vegetation, and shows that they depend neither upon climate nor upon the altitude, but chiefly upon the course of the river.

ACCORDING to La Nature, the telephonic service of Paris, rapidly developing of late, will soon include an immense central telephonic office in the Rue Gutenberg, capable of serving directly 30,000 subscribers, without connection with the other offices of the quarter The work is being actively pushed forward. Cables are being laid in the sewers, an enlargement of which, at certain points, is rendered necessary. There were 7800 subscribers in Paris last October Paris lias now telephonic communication with Brussels, Marseilles, Lyons (which also communicates with Marseilles), Lille, Havre, Rouen, and London. Twenty-eight towns in France have a telephonic system. There are two in Algeria, in Algeria and Oran. Lille and Roubaix, Lille and Dunkirk are connected by telephone and, ere long, connection will be formed between Lille, Valenciennes, Calais, and Fourmies, between Lyons and Saint Ettenne, between Dieppe and Rouen, between Marseilles and Nice

The climate of the Greek island. Cephalona has been lately described by Dr. Pattack (**Zermann*** Afril.**) We note the following features: At Argustol temperature reaches a maximum in July (2, 3 °C,) whereas Corfu and Pattant does so in August. With several days' calin and bright sumbine, in the buy, the air, laden with moisture, becomes unbearably hot and close Yet the nativer go but little to the wooded halls behind, where the temperature goes down sometimes to 15° 5°C. or lower. Males bing down asometimes to 15° 5°C. or lower. Males bing down asom qilghty, in summer, from covered puts in the

hills, for supply of restaurants, &c. As to rain, there is a sharp contrast between the wet winter-half and the dry summer-half of the year The annual rainfall (36 years) was about 35 inches. The autumn rains are ushered in by severe thunderstorms. November and December are the wettest months, but about Christmas there is usually a short time of fine weather. March is extremely variable, and often very cold With May begin the rainless months, and the drought is sometimes considerably over 100 days Five months have sometimes passed with but a few slight showers On this greatly depends the currant cultivation a brief downpour may spoil the crop Snow falls seldom in Argostoli, but often on the bills. Dew is plentiful in summer. but its salt precipitate is feared. Wind is greatest in winter, southerly winds prevailing, especially south-east A hot south wind (the lambalitta) blows, rarely, in early summer, and with evil effects to vegetation The fresh north-west wind (maestro) brings cumulus clouds on the hills

MR F HOWARD COILINS, the author of a useful epitome of Mr Herbert Spencer's system of philosophy, has written a pamphlet in which he discusses the causes of the diminution of the jaw in the civilized races. In opposition to the views of Weismann, he contends that the phenomenon is due to "disuse"; and the argument, as he presents it, deserves to be seriously considered. Some time ago Mr. Collins sent to NATURE a letter in which he gave some account of the ideas which he now expounds more fully. In the preface to his pamphlet he seems to imply that the letter was not inserted because, according to a belief said to be current among certain biologists, the editor of NATURE is "more willing to publish letters contending that acquired faculties are not inherited than those contending that they are " Mr Collins has too readily allowed himself to be influenced by the belief of "certain biologists" If he supposes that it is possible for the editor of NATURE to print all the letters sent to the paper for publication. he must have a very madequate conception of an editor's functions

To throw light on some physiological processes, Herr Hofmeister recently experimented (Archiv fur experim Pathol) on the swelling of plates of gelatine in various solutions ; the plates heing taken out from time to time, dried, and weighed salt solutions of various concentration, the gain of weight was large in the first days, then gradually fell off, as in former experiments with pure water. The effect varied with the nature of the salt, and even with solutions holding the same number of molecules in 1000 parts water, the swelling varied as much as five fold. This difference, it is pointed out, is related to attraction of the salt for water, the greater the attraction, the more difficult the entrance of water into the plate. But that this is not the only factor is proved by the swelling in pure water being always much less than that in the solutions. Experimenting with ordinary salt, the gain of weight proved to consist both of water and salt, both dependent (but differently) on concentration With increase of the latter, the gain of water rises to a maximum (about 13 per cent.), then declines ; but the gam of salt goes on always increasing proportionally to the con-The remarkable property salts have of increasing the gain of water beyond what occurs in pure water is also shown by indifferent organic substances, as cane-sugar and alcohol. Experiments were further made on swelling of gela tine plates in methyl-violet solutions, and with the result that the concentration of the solution in the plates was always much greater (over 30 times) than that in the solution presented. The colouring-matter is taken up in relatively much greater quantity than the water Further, gelatine takes up somewhat more colouring-matter relatively from a dilute than from a concentrated solution. The forces concerned in these phenomena, and which are neither purely mechanical nor ehemical. Herr Hof meister brings into analogy with those occurring in absorption of gases by liquids, the reciprocal solution of liquids, adsorption of gases on solid bodies, &c

THE Photographic News quotes the following from the Scientific American, December 0, 1848 :- "New Electrical Light -The inventors of a new electrical light, exhibited at the Western Literary Institution, Leicester Square, London, on its recent reopening under the new auspices, expect, it is said, to apply it generally to shop and street illumination, and they state that, while the conveying will cost no more than gas, the expense of illumination will be one-twelfth the price of the latter light The current of electricity, in passing through the two pieces of chargoal which form the poles of the circuit, and are excluded from all access of air, gives, in this case, it is said, an intense and beautiful white light, with the effect of daylight, to a much greater extent than the lime does, and having this advantage, that it is sustained and continuous. If Messrs, State and Petrie can thus produce a steady and sustained light they have accomplished what has hitherto been the sole preventive to the substitution of galvanism for gas The Mechanics' Magazine states that this one light completely eclipsed ten gas lights and an oxyhydrogen The gas companies had better look out. The dissatisfaction of the public with their mismanagement may have begotten a rival destined to eclipse many more than merely ten of their gas lights."

WITH the view of certifying to the efficiency of teachers of public elementary schools to give instruction in woodwork in accordance with the provisions of the Code (1890), the City and Guilds of London Institute is prepared to issue certificates to qualified teachers of public elementary schools on the following conditions -The candidates will be required to give evidence of having regularly attended during each of two sessions, a course of at least twenty practical wood-working lessons in a school or class certified by, and under an instructor approved by, the Institute The candidates will further be required to pass an examination at the end of each year's course, to be conducted liv examiners appointed by the Institute, and to pay a fee of five shillings for each examination. For the first year, candidates who have attended an advanced course of instruction will be exceptionally admitted to the second year's examination without having passed the first, and will be eligible for the teacher's certificate. The examination fee for such candidates will be ten shillings. The written examination will include questions founded on such subjects as the following :- Woods. -Places from which some of the commoner woods are obtained. Their characteristic properties and uses. The general structure of cone bearing and leafy timber trees. The meaning of seasoning timber. Effects of thrinkage and warping. Identification of specimens of wood The questions will be limited to oak, ash, elm, beech, mahogany, sycamore, basswood, white deal (spruce), red pine (Scotch fir), yellow pine.

Das Watter for July reports a curious case of globular lightning which occurred at Berga, near Schlieben, in Germany, between 3 and 4 o'clock on the morning of July 1. The lightning entered the chimney and split into two parts, one portion ran along the rafters of the roof, and the other entered a bed-room occupied by a man with his wife and three children The man, who was up, on account of the violence of the storm, saw the ball jump on to the bedstead, which it broke, and from there it slowly travelled to the opposite side of the room, and disappeared, with a loud crash, through the wall. None of the occupants were injured, further than being deafened for a short

THE additions to the Zoological Society's Gardens during the THE additions to the Zoological Society's Gardens during the Advances in Knowledge and Teaching due to Experimental past week include a Banded Ichnoumon (Herrester fascialus) Method.—These changes have occurred both in the profession NO. 1136, VOL. 44]

from West Africa, presented by Dr. Arthur Williams; a Black Stork (Ciconia nigra), European, presented by Lord Lilford, F Z S.; two Nilotic Crocodiles (Crocodilus vulgarii) from Africa, presented by Dr. Lester; two Black Storks (Ciconia mgra), European, two King Parrakeets (Aprosmictus scapulatus) from New South Wales, purchased, a Laughing Kingfisher (Dacelo gigantea) from Australia, deposited.

OUR ASTRONOMICAL COLUMN.

RESEARCHES ON THE MEAN DENSITY OF THE EARTH -The Monthly Notices of the Royal Astronomical Society for June contain a brief account by Prof A Cornu of the experiments M Baille and himself have been making for some years to deter mine the mean density of the earth. The apparatus employed is fundamentally the same as that used by Cavendish. It consists of a horizontal aluminium rod, suspended by a torsion thread 4 metres long, carrying at each end a ball of copper, bismuth, iron, or platinum, and at its centre a vertical mirror reflecting the divisions on a millimetre scale 5 metres away Two globes of mercury are used to produce the torsion couple. The displacements of the seale-divisions are observed with a telescope, I wo globes placements of the seale-divisions are observed with a telescope, and indicate the angular displacements of the rod. The chief suprovements which have been made upon the appurises used to approximate the support of the control of th quickly filled with mercury has been advantageously substituted for the movable lead weights (3) The complete oscillation of the halance arm is registered on a chronograph by observing and recording the transits of the reflected scale divisions (4) The use of an annealed glass fibre to eliminate errors due to dis placements of the zero point (5) The screening from variations placements of the zero point (5) The screening from variations of electric potential by putting all parts of the apparatus in metallic connection with the earth (6) The copper case protecting the balance arm is a good conductor of heat, and of sufficient thickness to eliminate the disturbances due to variations in temperature. The authors hope soon to obtain an estimation of the prohable error of their measures, and to arrive at a definite result for the constant they are determining.

PARALLAY OF P URS 4 MAJORIS -- Vol xxxviii of the "Astronomical Observations of the University Observatory of Konigsberg" contains the heliometer observations of P Urse Konigsberg" contains the heliometer observations of P Ursæ Majoris (Arg. Octizen 11677) made by Dr. Julius Franz, from which he deduces the parallax o" 1002 ± 0" 0065, or approximately 0" 10 ± 0" 01

THE PROGRESS OF MEDICINE.

THE Bournemouth meeting of the British Medical Association has been a great saccess, and a great deal of useful work and discussion has been recorded. Among the addresses we may refer to the President's (Dr. J. R. Thomson), on the present position of medical officers of health, of Dr. Lauder Brunton, on twenty-five years of medical progress; of Dr. J Chiene, on rest as a therapeutic agent in surgery, and others on lunacy legislation, the uses and prospects of pathology, &c We make the following extracts from Dr. Brunton's address,

which presents us with a most admirable and masterly analysts of recent progress -

... Perhaps there is no period in the whole history of medicine in which such rapid changes have taken place as in the last five-and-twenty years. It is impossible to give anything like a complete account of these in the brief space of one hour, and I compute account or trees in the brief space of one hour, and I shall therefore retariet myself to a few of the more prominent points, and especially those that have come directly under my personal cognisance; for, like the man who made one-half of his fortness by attending to his own staffars and the other half by leaving other people's alone. I may probably unlike the time at my disposal best by speaking of what I know myself and leaving other things own.

itself and also to some extent—in this country at least—in the education and training of the men who enter it. We notice, education and training of the men who enter it. We notice, first, that a very great increase has occurred in the knowledge of the nature, causation, and treatment of diseases possessed the profession as a whole, but perhaps a still greater gain is the general adoption of the experimental method by which most of our recent knowledge has been acquired, and from which we may hope for even greater advantages in the future. In correspondence with the acquirement of knowledge, we notice also a spondence with the acquirement of knowledge, we notice also a great alteration in the teaching of medicine, and especially prominent is the tendency to make such teaching practical instead of theoretical by training men to place their dependence upon objective facts, and not to receive without experimental data the theories or speculations of any master, however great - he may be. .

Direction of Advance —The greatest advance made in the last twenty-five years has been in the direction of the accumulation, co ordination, and teaching of facts instead of theories, of the phenomena of Nature as opposed to the fancies of the human mind.

Co ordination of Facts -But the mere accumulation of facts is of little use unless they can be so arranged, compared, and grouped as to bring them into relationship with some general law, and this we find in the world's history has been done from

iaw, and this we find in the world's nistory has oeen cone from time to time by some master-more, but in its principles and practice, is really a subdivision of biology, and this, like all practice, is really a subdivision of biology, and this, like all other branches of knowledge, has been most profoundly modified by the general acceptance of Darwin's great thoughts—the doctring of evolution, the strungle for existence, and the survival Wherever we turn we find that Darwin's influence of the fittest has modified the direction of thought, and whether the study concerns the evolution of the elements, the evolution of the plane-ary systems, of living beings, of communities, of customs, of laws, ary systems, of living beings, of communities, of customs, of laws, of literature, science, or art, in every department of human know-ledge we find that men, consciously or unconsciously, are influenced by Darwin's work. It is with shame I confess that five and twenty years ago, although I had taken a University degree not only in years ago, although I had taken a University degree not only in medicine but in scence, and might therefore be supposed to be of his "Origin of Species," and I first heard its name in Vienna from the lips of an Austrana who was speaking of it in terms of the highest praise. "Visht is 17" I asked, and my question the highest praise "Visht is 17" I asked, and my question it causes myself now, when the possibility of sixth giperance seems to me, as it must to you, almost increable, and yet such was the fast. The publication of Dawran's "Origin of Species," in 1859, has done more to change the current of human thought than anything else for centuries, but while its influence is every-where felt, biology and all its subdivisions have been more especially affected

Changes in Medical Students - But great as the changes have been during the last five and twenty years in the profession itself, they are perhaps quite as great in the men who enter

Long ago the ductor's means of diagnosis consisted in inspecting the tongue, feeling the skin, counting the pulse, shaking the urine, and looking at the motions and the sputum. But now, in urne, and looking at the motions and the spatium. But now, in addition to a through training in ausualitation and percession, students have to learn the use of the laryngoscope, ophthalmoscope, and obscope, and obscope, and obscope, and obscope, and obscope, and the application of electricity. They have to acquire a knowledge of the chemistry of the urne and its alterations in disease, and, what takes still more tune, they have to learn the microscopical appearances, not only of the tissues and excretions in health, but their alterations in disease, and must be acquainted with the methods of staming so as to

and must be acquanted with the methods of staming so as to detect tuberle boalin and other disease germs. Dispariments of Greatest Advance—Fire and wenty years Dispariments of Greatest Advance—Fire and wenty years ago we knew only too well that typism was indections, and that premis and expupelss were likely to spread in a ward when these descens as we do now, not had we the same means at our disposal wherewith to combat them. The departments in which the greatest advances have been made within the last five-and-twenty years are in those of fevers and diseases of the nervous system. A new ers in the study of the latter was forestandowed by the appriments of French and Hitage in the busin of the collisions of the cortical centres, both motor and sensory, in the greatest advances have 6een mode within the last five-analy of the Spaniards of the Cordilleras. Their cupidity of the merions to entirely sense are in those of fevers and diseases of the nerrous to the control of the sense of the sens

that of man for experiments upon it to be of much practical use in the diagnosis of human ailments, while the likeness in the brain of the monkey to that of man at once allowed conclusions drawn from the experiments upon the former to be transferred upon the latter Vet if we try to describe in one word the dedrawn from the experiments upon the tormer to oe transærrea upon the latter. Yet if we try to describe in one word the de-partment in which medicane has made the greatest progress within the last quarter of a century, that word must be "fevers", for during this time we have learned to recognize fever by the use of the thermometer in a way we never did before, we have learned the dependence of the febrile process in the great majority of cases upon the presence of microbes in the organism, and we have become acquainted with an immente number of chemical substances which have the power both to

numer of chemical substances which have the power out of destroy the microbes and to regulate the febrile process.
**Introduction of the Thermonictes —It is true that the thermonecter was used by Danelssen, in leprosy, before the year 1848, and its more general use began with Wunderlich's observations nearly thirty years ago, but it is only within the last five-and twenty years that its use has become at all

Nature of Fever —The thermometer has not only enabled us to detect the onset and to watch the progress of fever, but in to detect the onset and to watch the progress of fever, but in conjunction with microscopical research, physiological experi-ment, and chemical analysis it has enabled us to gain a fulfer know that during it the organism is consuming raidyly, or, as Dr. Dorald MacAhster graphically says, it is like "a candle buring at both ends," and we have learned scientifically the reasons for the practical treatment, of which Graves was to proud that he witce as has own egipth, "It led fevers." We have learned also, to a great extent, the necessity for the elimina-tion of the waste products, or ashes as we may term them, which the excessive combustion produces, and thus we know why the surgeon is so anxious regarding the result of an operation when the kidneys of his patient are inadequate. For if any febrile attack following the operation should lead to increased demands upon these secreting powers, they might fail to meet it, and the retained exciets would potson

the patient
New Methods — The rapid increase in our knowledge has
been due not merely to the constant use of old methods, but seen oue not nerely to the constant use of oid methods, but to the introduction of new ones, and more especially to the general recognition of the fact that the same strategy which has other proved so successful in war is to be applied in attacking complex problems. They are to be separated as far a possible into their several components, and each of these is to be overinto their several components, and each of these is to be over-come in detail. As presented to us by observation at the bed-come in detail. As presented to us by observation at the bed-and we are only succeeding in doing it by examining the various factors one by one in the laboratory. The greatly in-creased powers of the microscope and the better methods of illumination have been of the greatest service, but their shifty illumination have been of the greatest service, but their shifty would be very much less than it is had it not been for the general introduction of the microtome and the invention of new inethods of staining When I was a student the microtome was only used for cutting sections of wood in the class of practical botany. About that time it was employed by Mr. Stirling, botany. About this time it was employed by Mr. Strings, Porf Cooder's seastant, in the preparation of sinnel insuer. For Cooder's essantant, the preparation of sinnel insuer. Rutherford The facility with which sections are made by it has nade microcopepair research much less teclious, and has embled trained histologists to do more work in a given time, which is the contract of the more than the contract of the more than the contract of the microbe which are so important in the crocognies most of the microbe which are so important in the causation of disease

Good Out of Evil.—It is very interesting to see how good may come out of evil, and a striking illustration of this is afforded by the history of medicine in the period we are now another by the interpol mental that we can trace a great part of our knowledge of disease germs and of the antiesptic remedies we use in treatment to the cupidity and stupidity of the Spannards of the Cordilleras. Their cupidity led them

would make his fortune. Amongst others, Perkins tried to do this, and, although he failed, yet in the attempt he discovered this, and, althougn ne tailed, yet in the attempt ne uncovered the anilin dyes, whose staining powers have not only helped us so much in ordinary histological research, but have made it possible to distinguish disease germs which without them would have been invisible. But the discovery of the anilin colours was only one outcome of the attempt to make quinine syntheticompounds has led to the production of salicylic acid and acetanisde, antipyrin, phenacetin, and all the other antipyretic remedies whose number is probably legton, and whose names already have become so numerous as to be troublesome. Here we see good has arisen out of evil, for if the pince of quinine had not been so high, the researches which have proved so useful

might not have been begun even yet

Small and Great, Foolish and Wise — In looking at another of the greatest advances which medicine has made-namely, the ledge of infective disease—we can see how enormous re nations may be consequent upon a research which many men would have termed useless or even frivolons. I can hardly fancy any better illustration of St. Paul's observation about the foolish things of this world confounding the wise than Pasteur's researches on tartaric acid, for what could seem Pasteur's researches on lartaric and, for what could seem more foolish to the so called practical man than the question, "Why does a crystal of tartaric and sometimes take one shape and sometimes another?" Wet from an attempt to answer this question has arrien the whole of Pasteur's work on fermentation in general, and on that of winc, beer, and vinegar in particular, whereby he has been able to save millions. to his country by accelerating the production of vinegar and pre-venting the souring of wine and heer. His observation that venting the votting of wine and heer. His observation that its rate and commitment turned the ray of polarization to the right, sometimes to the left, that, indeed, there were two could be combined to the control of the result dextro tartaric acid, and leaves the leevo-tartaric acid behind This led him to investigate such minute organisms, and, by simplifying the soil in which they grew, and separating the organisms one from another, he learned the conditions of their growth, and showed that most processes of fermentation were due to the presence of living organisms. It is true that while Pasteur was still a boy at school, Peyen and Persoz had shown that the liquefaction of starch and its conversion into sugar was due to diastase, and that Dumas in a report on a paper by Guérin-Varry had pointed out that, although unlike diastase, the active principle of the gastric juice had not been isolated, it was probably a ferment of a somewhat similar kind. Dumas classed yeast as a ferment along with diastase, and the fact that such a process as conversion of starch into sugar could be effected without a living organism naturally rendered it all the more difficult for Pasteur to prove his thesis that most fermentations were due to living organisms.

were due to living organisms.

**Chemical and Bislogical Freurs of Fermentation — The two
views of the action of ferments—namely, the chemical and the
biological—may, I think, fitly be likened to Pastur's two kinds
of tartanc acid, each by itself being lopsided and incomplete,
forming a symmetrical whole only when united. There can be
no doubt of the truth of the chemical view that dissistees not at no coup or the run of the enement view that masks is not a living organism and yet convents starch into sugar. There can through the run of organisms which cause fermentation are living bodies, and that without the presence of these living bodies alcoholic, acetic, and other forms of fermentation would not exist. Metrobet and Euspines. But recently we have come to gre-

cognize that these living organisms may produce their effect by manufacturing chemical ferments, and that these ferments may occasionally do the work, although the organisms which may occasionally do the work, atmough the organisms waiter form them may be absent. It is quite true that it is difficult —perhaps impossible—to get fermentation from the dead yeast plant, but we may find a parallel for this in the fact that the pancreas of the higher animals sometimes yields an active ferment and sometimes not. Nor need we wonder that active rements produced by microbes have but a slight action com-pared with those of the microbes themselves, if we remember how very little power of digestion a dead pig's stomach has as compared with the amount which can be digested not by the live animal itself only, but by the herds of swine consisting of its "fathers and mothers, its brothers and sisters, its cousins and during all the term of their natural lives , for in the process of fermentation microles are growing, fermenting, and process of fermentation microbes are growing, fermenting, and dying with great rapidity, and many generations occur in a fermenting fluid in the space of a few hours, so that the total effect they produce will be out of all proportion to any which can be got from the microbes themselves at a single instant.

Microbes and Disease -- From organisms as a cause of fer-mentation and of the diseases of wine and beer. Pasteur went on to investigate their action as causes of disease in living beings

on to investigate their action as causes of divease in living beings—first in the silkworm, near in the lover animals, and, lastly, in man. It established the dependence of the silkworm disease and of animars upon the presence of specific microthes which distributes the silkworm disease and restored the silk should be silkworm to read extension and restored the silk should be silkworm to read the silkworm of Distant Germi — Flux while this survestigation is interesting to us as illustrating the probable cause of the disappearance of typhus fever, to which I have already alluded, Patseirt's researches on anithrax are still more important as Pasteury researches on antirox are still more important as bearing upon the question of protective inoculation; for he bearing upon the question of protective inoculation; for he body and grown in flasks under varying conditions, some of which were favourable and others unfavorable to its growth High temperature enfeebled the wrus, so that it no longer killed an animal with the same certainty, and by involuting first with a weak virus and then with one successively stronger and stronger, he found that animals could be completely protected either fi inoculation by the strongest virus or by infection from other

animals suffering from the actus disease

Increase in Vivulence of Disease Germs —Another extraordinary fact which he made out was that the virus thus weakordinary fact which he made out was that the virus thus weak-ned, so that it will not kill a guinea-pig a jear old, and still less a sheep or ox, may again be rendered most potent by inoculting the property of the property of the property of the property of this older and stronger guines pig's, the strength of the disease garms, increasing with every inoculation, until finally sheep and cows may be killed by it. We can thus yee how an epidemic of disease beginning sporadically, and attacking weak individuals may gradually acquire such strength as to attack and carry of

the strongest

the strongest Pont Chilines: —Pasteur's plan of growing disease germs out-side the body in broth, although of the utmost value, did not allow a convenent esperation of different germs, but this can now readily be done by Koch's plan of sowing them, not in a bround medium, hat on solid gelatine spread on glass plates, so that the growth of the germs can be daily watched under the microscope, and inoculations made from single colonies on other plates until pure cultures have been obtained. By thus isolating piaces until pure cultures have been obtained. By thus solviting the different microbes, we learn their life history, the mode in which their growth is influenced by differences of soil, of temperature, of moissure, by the addition of various substances which either favour or retard their growth, and, last but not least the effect which pre-success the substances when the substances where the substances when the substances when the substances where the substance least, the effect which one microhe has upon another when they are grown together at the same time

Struggle for Existence amongst Microbes -For even among these minute organisms the struggle for existence and the survival of the fittest exists, like that which Darwin pointed out

so clearly in the case of higher plants and animals

Struggle for Existence between Microbes and the Organism — But it is not merely hetween different species of microbes or different cells in an organism that this struggle occurs. or otherent certs in an organism that this studge occurs. It takes place also between the disease germs and the cells of the organism which they invade, and the result of the struggle may be determined, not by some powerful sgency which weakens or destroys either the organism or the mi crobe, but by some little thing which simply inclines the scale in favour of one or the other. Thus, in the potato disease, the victory of the invading microbe and the destruc-tion of the potato, or the death of the microbe and the health of the tuber, may depend upon some condition of moisture or possibly of electrical change in the atmosphere which aids the growth of the microbe disproportionately to that of the potato.

These almospheric conditions need not necessarily be antagonistic suces amongoneric conditions nect not necessarily or amongonistic to the potato, they may even in themselves be advantageous to n, but if they help the microbe more than the plant, the microbe will gain the victory and the plant he destroyed Fight between Cells in Higher Organisms—The fight between

the organs which Æsop describes in his fables actually occurs between the cells in some vertebrate animals, and the schism predicted by St. Paul as the result of such a fight actually takes place For in the tadpole, at one stage of its existence some of the cells at the base of the tail begin to eat up others, with the result that schism occurs and the tail falls off

result that schism occurs and the tail sails of Phagey-toris.—This struggle for existence between the cells of an organism and microbes has been beautifully shown by Metschnikoff in the Dapline or water flea, where the process of the cells cating up the microbes or the microbes destroying of the cells eating up the microbes of the microbes destroying the cells can be actually observed under the microscope. This process of phagocytosis is now regarded by many as only a small part of the struggle between an organism and a microbe, but it is impossible to see one part of a microbe half diageted by the cell in which it is embedded, while the part outside remains unaltered, without believing that the process is one of great miprofuse. At the same time, it seems that the process of phagocytosis, where the microbe and the cells meet in close conflict, bears about the same relationship to the total struggle that a bayonet charge bears to a modern battle. The main part of the fight is really carried on at some distance by deadly weapons—by bullets in the case of the soldier, and by ferments, poisonous albumoses, and alkaloids on the part of the cells and the microbes. In some of Metschnikoffs observations we can almost see this process, for he has figured leucocytes dead, and apparently burst by the action of conidia, lying close to but yet outside them, as if these conidia, I ke the dragons of fable, had spit out some venom which had destroyed them

Venom of Murobes .- Within the last few years attention has been gradually becoming directed less to microscopical ex-amination of the microbes themselves and more to chemical investigation of the ferments and poisons which they produce; investigation of the ferments and possons which they produce; yet, strangely council, the very moment when chemistry is written to the contract of the contrac

microbes are nearly allied, chemically and physiologically, to those formed in the slimentary canal of the higher animals by digestive ferments, it is natural to suppose that microbes, like the higher animals, split up proteids, starches, and sugars by enzymes, which they secrete, and which in both cases may be enzymes, which they secrete, and which in both cases may be obtained apart from the living organisms which produce them, that, in fact, we should be able to isolate from microbes bothes which correspond to pepsin or tryptin, just as we can stolate these from the stometh or pancreas of an animal. In some, although not in all cases, this attempt has succeeded. *

Processor Allumous** — The allumous produced by microbes

resemble those formed during normal digestion in being poisonous when injected directly into the circulation, although they msy not be so greatly absorbed from the intestinal canal. One of the most remarkable discoveries in regard to albuminous bodies is the fact that some of them which are perfectly innocuous, and, indeed, probably advantageous to the organism in their own place, become most deadly poisons when they get out of own place, becules most deathy poisons when they get out of it. Thus, the thyroid and thymus glands, which are perfectly harmless and probably useful, were found by Wooldradge, when broken up in water, to yield a proteid which instantaneously coagulated the blood if injected into a vein, so that the animal died as if struck by lightning; while Schmidt Muhlheim, under Ludwig's direction, found that peptones had an exactly opposite effect, and prevented coagulation altogether

effect, and prevented congulation slogether.

Naturalization of Fluoreau Allementer—Perhaps the analogy is too vague, but we seem to find here sometiming very lake pratectar ive obtained furnation and con counting polarized light pratectar in the state of the state

"I Vide Brunton and Macfayden, Crooman Lectures on "Chemical Struc-ture and Physiological Action," British Medical Journal, June 15, 1889, p. 1376.

sither one or other alone might be a deadly poison. The albumoses formed by microbes appear frequently, if not alway, animals. Pasteur's treatment of hydrophoba is based on the idea that the spinal cord of rabid animals contains a virus, and that student—Koch's tuberculio—may be sumiar in this respect,

at antidote—Koch's tuberculin—may be similar in this respect, and may yet, by suitable discrazione, fulfil the hopes of its able and single numbed discovere—Perhaps a similar process of splitting up and recombination may explain the formation and disappearance of the ensymes, such as pepara not trypting by which digestion at carried on The pancers of a fasting animal will not digest albuminous bodies like fivine, while the pancers of an animal killed drum; full digestion will do or mother substance, which yields the digestive ferment, and, as Kuhne has shown, by treating it first with acid and then as Kilme has shows, by tresting it first with acid and then with alkali, it becomes active. Again, to reser to the analogy of Patters's tarrant acid, we seem to find that the inactive, and the process of the state of the process of the process of the process of dispetsion in life, and yields the lopsided and active panceaute ferment But, if this be so, what because the process of the process o destroy sugar.

destroy sugar.

Immunity —We must be very careful in our speculations, and test them by experiment, but such observations as these may tend to throw some light upon the nature of immunity may tend to throw some light upon the nature of immunity immunity is probably a very complex condition, and is not dependent allogether upon any single factor, but we can now understand that if a microbe has guined an entrance into an organism, and produces a proteid or an albumo-e postenous to the organism which it enterer, it may grow, three, and destroy that organism, while the injection of some other proteid which would neutrilize the posion might save the admini

seed which would neutralize the poison might save the animal while the mercobe would perilamkin has found that, while a mouse inoculated with anthrax will die within twenty-four hours, a rat resists the poison altogether; but if the mouse fire being inoculated with the disease has a few drops of rat's serum injected into it, instead of dying, as it would otherwise certainly do, it survives just like the rat, and from the spleen of the rat Hankin has isolated a proteid which has a

Similar protective action to that of the serum

Cure for Tubercle.—Working on similar lines, Bernheim and Cut for Island A. Working on similar lines, Bernheim and Lepine used the injection of goal's blood in phihiss so as to stop, if possible, the progress of tubercle, and Richet his used the serum of dog's blood, for the goat is quite immune, and the dog is to a great extent, though not entirely, immune from attacks of tuberculous. The injection of goal's blood in somewhat large quantities has been given up, while dog's and goat's serum in small quantities of 15 to 20 minus.

dog's and goat's scrum in small quantities of 15 to 20 minims at intervals of several days a still under trial

Action of Blister:—But if immunity can be insured by such alight changes in the organism as a few drops of serum from a rat will produce in the body of a mouse, it is natural to suppose that a similar change might possibly be effected by removing the albuminous substance from one part of the body, and introducing it, perhaps after it has undergone slight change, into another. As I have already mentioned, the change, into another. As I have already mentioned, the albumness of ordinary digention are positioned when they are injected into the circulation, and as are the proteed substances obtained from the thyroid and thymus glands. Why, then may not the seram of one's own blood, withdrawn from the vessels by a billier and reabsorbed again, not be as good as the serum obtained from the blood of an animal?

Bleeding .- It is quite possible, too, that the good effects of

Bliefang.—It is quite possible, too, that the good effects of beeding may be due to a maintar cush name holy is a most complex pucces of mechanism. We learn its action bit by its good to the complex pucces of mechanism. We learn its action bit by its good to good to good the little piece which attracts attention at the moment as all-important to the moment of the complex pucces of the piece which attracts attention at the moment as all-important to the complex pucces of the piece which attracts attention at the moment as all-important to the complex pucces. The piece which attracts attention at the moment only for the team tendency manifests steelf in the pursuit of knowledge of all kinds, yet its me medicine more specially that this tendency comes to

be a matter of life or death, for upon the medical view prevailing at the moment medical princice is agit to depend, and erroneous views may lead to the death of many patients. So ong as practice depends upon theories, unchecked by expericertain, and dangerous. One of the greatest guns of the last five-and-westly years is the general introducion of the experimental method, and the labolt which has been growing up method data. Specialtons such as those in which I have been indulging in regard to binsters and bilood-letting are useful as indicating lines of experimental research, but until data. Specialtons such as those in which I have been indulging in regard to binsters and bilood-letting are useful as indicating lines of experimental research, but until data. Specialtons such of the prefer the providege is almost sure to lead to one-sided practice, and thus, diverging further and further from the truth, each at last in flatheood and and further from the truth, each at last in flatheood and

"Metapota.—Perhaps no better example of this can be found than antaspice surgery, from the time of the good Samantan down to Ambrouse Paris and Str Joseph Lutter. The good Samantan bound up the wounds of the goot traveller, pour-based of the poot traveller, pour-based of the poot traveller, pour-based paris of the poot traveller, pour-based paris of the metapota paris, when his outments ran out, could not sleep for thinking of the muserable soldiers to whom they had not been brouse Pare, when his outments ran out, could not sleep for thinking of the muserable soldiers to whom they had not been than the properties of the properties. The properties of the properties of the properties of the properties of the properties. The properties of the

Distription — But it is not only in surgery that recognition of diseased germs as a source of danger to the organism has led to their destruction outside the body, and insured safety from their attack. This occur in all infective diseases, and this term now includes many which were no formerly regarded as such, for nather consumption not pneumonus was formerly to the safety of the safety of

and offly interest, on the second of second of the second of the causes of spidermic diseases, hey were utterly unable to combat them, and they either in lary slew defencelrs people for posoning the wells, as in the Middle Ages, or appointed days of fisting and prayer, as in our own times. But note an epidermic is known to depend upon the presence of a ceriain organism, precention can be taken for destroying the lessening the usetypibility of the organism to its ravges made the body by inoculation, or combating its effects by means of antipyratics. A knowledge of the life-history of merobes has embled us to sacertain the power of different substances, there to destroy them completely or to serve to restend their venue of the diseases which these microbes might otherwise

Antivivuection,-Every now and again a loud outery is raised

against this method, partly from ignorance and partly from prejudice. Many—probably met—of the opponents of experiments on animals are good, honest, includested people, who mean
on animals are good, honest, includested people, who mean
well as animals against man, or are maided by the false satiements of the other class. These are persons who, blinded by
prejudice, regard human life and human suffering as of small
man is better than anny sparrows, and who, to the question
that was put of old, "How much, then, is a man better than a
sheep?" would return the reply, "If it is no better than a
sheep?" would return the reply, "If it is no better than a
sheep?" would clause the control of the property
pans of dessease both in man and also in animals, for they, like
us, are lable to disease, and, like us, they suffer from it I
may perhaps be tallowed to queed we sentences from a paper
pans of dessease both in man and also in animals, for they, like
us, are lable to disease, and, like us, they suffer from it in
may perhaps be to them of the suffering the
sale time before any anitaryies of
permental pharmacology —"I've witings are more distressing
annowly looking to him for that relief from pan which he feels
himself utterly unable to afford. His sympathy for the sufferer,
and the regret be feel for the meptopicnes of he art, engave the
urgent stimulus in his search after the causes of the yan, and
the means by which it may be allessent ("Land," Jul 27, "

Gains by Experiment an dissimil.—It is said that our months are full of promuse, but our having are empty of results. The server to this is, that anyone who doubts the utility of experiments of the control of the con

helped towards its general acceptance in this country.

Future of **Paramenelogy*—Bits perhaps the most promising thing about pharmacology is that we are now just beginning thing about pharmacology is that we are now just beginning thing about pharmacology is that we are now just beginning as a state of the physiological action that we can, to a certain extent, predict the action of a drug from its chemical structure, and are able to produce new chemical compounds thaving a separative distribution of the production of the action of the production of the action of the print of giving to each one the precise action which would make it most suitable in any particular case, we may be able, from noticing one of its actions, to infer that it possesses others. We are, indeed, giving a knowledge of the action of drugs both of known and unknown chemical structure of the production of the production of the action of drugs both of known and unknown chemical structure.

THE INSTITUTION OF MECHANICAL

THE summer meeting of the Institution of Mechanical Engineers was held at Luverpool last week, commencing on Tuesday, the 28th uit, and concluding on Freday, the 18th uit, and concluding on Freday, the 18th uit, and concluding on Freday the 18th uit and the 18th uit of the 18th uit of the 18th uit of 18th The sittings were held in the concert-room of St. George's Hall, and the following list of papers was on the agenda: review of marine engineering during the past decade, by Alfred Blechynden, of Barrow-in-Furness, description of the ware Bleshynden, of Bairow-in-Furness, deserption of the ware-house and machinery for the storings and trained of gain at the house and machinery for the storings and trained of gain at the on the experimental engine and the alternative testing machine in the Walker Engineering Laboratories of University College, Liverpool, by Frof. H., 5 Hole Shaw, of Liverpool; on the Liverpool, by Frof. H., 5 Hole Shaw, of Liverpool; or the Manchester Ship Canal, by Jr. Leuder Williams. Engineer-in-Chief to the Canal Company. There was also a paper on the Liverpool water-worsh, but this was adjourned to the next

The Institution having been welcomed to Liverpool by the Mayor, Mt. J B Morgan, and the formal lastiness having been transacted, Mr. Blechynden's priper was read. Mr. Blechynden and the St. Detector, Bramwell. has taken up the work commenced by bu Frederick Bramwell at the Liverpool meeting of 1872, when the latter presented an historical paper giving a review of manne engineering up to that time. In 1881, the lastitution met at Newcasile, when Mr. F. time. In 1881, the festitation and at Newcoth, who Mr F C, Marshall, will known Tymesule organeer, real a paper which consisted of a retro-pect of the name years since Sis Prederick Brannelly's paper had been send. We now have Mr Blechyndan cariying on the work. These periodical is eval war are instactive. Here cannel the eageneet to take stock of the transpect of the stock of pressures averaged 77'45 pounds per square inch, the average piston speed was 467 feet per minute, and the heating surface per indicated horse-power was 3 99 square feet The consumption of coal per indicated horse-power was 1 828 pounds per hour As a contrast to this, Mr Blechynden tells us that at the present time the three stage expansion engine has become the rule, and the bottle pressure has been mersased to 160 pounds, and even as high as 200 pounds per square under Four-stage expansion engines of various forms have also been adopted. Forced draught has come to the front-stage expansion expansion been adopted. Forced draught has come to the front-stage of the found to time the three stage expansion engine has become the rule, that we do not always place full reliance in the details green with regard to fise economy in connection with mercastile with regard to fise economy in connection with mercastile the best performance of the engines, so that they are credited with a duty they cannot maniant commonuly throughout a voyage. Probably, however, the figures green by the author are accitated for comparative purposes, and they are not, as are accitated for comparative purposes, and they are not, as are to be true. We would here draw attention to the author's to be true. We would here draw attention to the author's expression "three-stage" and "for stage" compound engines. Engineers have been in the habit of referring to these types as a construction of the control of the Engineer have been in the habit of referring to these types is triple expansion and quadruple expansion engines. This no-cylinder compound, and even the simple non-compound engine expands the steam more than three or four times. Some engi-neers, recogning this, have used the terms "triple compound," or "quadr uple compound," but Mr. Blechynden's expression has

the merit of greater accuracy and simplicity. We hope that enthe merit of greater accuracy and simplicity. We hope that en-gineers, who are gut to be romewhat loose in the naming of objects, will adopt Mr. Blechynden's terms. Added to the paper are escalater seasons or the present day. A long discussion of followed the reading of this paper. It turned chiefly apon the question of forced draughly, corrugated flows, and the rules with regard to bolier testing which Mr. Sennett introduced when he was at the Admirally. With regard to the forced draughly question, the boiler testing with regard to the forced draught question, the very sensible opinion seemed to have been arrived at that forced draught, though a good thing in itself, may prove a great ill if overdone. It is in the Navy chiefly that forced draught though that a located draught that the second of the second o if overdone. It is in the Navy energy that forced draught has gained an evil reputation, and naval officers are largely to blame for this, although the engineers must take their share of the responsibility. When it was found how great an accession of power could be obtained by forcing combustion with a of power could be obtained by forcing combustion with a fan, naval officers thought they had a royal road to speed. Bollers which had been designed on principles that had grown up under a simple chimney draught rigitum, were triged by familiate to duties beyond their powers of endurance, and then, when tube plates buckled and tubes leaked, forced draught was said by gellant admirals to be "the invention of the Evil One." sad by gollant admirals to be "the invention of the Erd One."
the engineers, as we have said, were also to blaime. The
boiler liss always been the lahmad of the machinery
engine. As a consequence boiler construction has been a
matter of rule of themb, and, when the engineral railes upon
which it was based have no longer applied, the engineer has
matter of rule of themb, and, when the engineer list a
matter of rule of themb. The top of the the late of the
upon which to build new. The top pedo heat builders have no
trouble with forced draught, though they blow far harder than
torouble with forced draught, though they blow far harder than
good engineers—not mere blind followers of "practice"—
as was proved by the papier read alta tyrange on this valued
by Mr. Yarrow before the Institution of Naval Architects
a remark on the subject which might have increased mere and
a remark on the subject which might have increased mere a remark on the subject which might have received more a remark on the sanged which might have received more attention. It has long been claimed by the makers of this type of furnace that additional heating surface, and that of a most valuable kind, was obtained by the corrugations. This Mr. Gray said was a fallacy, for the heat from the furnace proceeded viay said was a fallacy, for the heat from the furnace proceeded only in radial lines, and therefore no greater effective area of heating surface could be obtained than that due to a plain cylinder

Mi Shapton's paper was an interesting description of the hulding and machinery referred to in the title, by which giain is trunsposited and stored. The warehouse in question consists this fly of a wax cellular structure which might be described as a brick and mortar honeycomb, filled with grain be described as a price, and morrar noneycomo, mace wang grain plate of honey. There are 250 heagonal bins or sites, each measuring 12 fect across the angles and 80 feet deep. The storage capacity is 2,240,000 bushels. The grain is lifted from vessels by elevators, and carned to the top of the building, from seesch by elevators, and carned to the top of the building, from shonce sertical movement was published by gravity. Horizontal trace is carried on by commons moving licht or bands which trace is carried on by commons moving licht or bands which had been seen to the seed of the description of the seen of the description of the seed of the description of the seed of the description of the seed of the the story action was in the country, the bins are made wholly of wood, but this is subject to rot, and harbours weevils. Sheet-iron rusts and birck retains moisture, so that with brick the grain heats unless well looked after and ventilated. On the whole, however, brick has the preference in this country. Sir James nowever, price has the preservice in this country. Sir James Douglass made a suggestion which will, we should think, receive tation of the Eddystone Lighthouse at the Royal Naval Exhibition as a building not altogether dissimilar from a salo. It has very thin walls, which are constructed of espanded sheet steel, or the sheared lattice work, which forms the bond for a crust of Ports. sneared sature work, which comes the active and rigidity, and one which would not have the same defect as briokwork with regard to harbouring damp. The problem of ventilating grain is one of difficulty; and it may be said that it has not yet been solved. The most serious effort yet made was the building of a granary on the banks of the Thanes, known, we heliver, as the Patent vertilating Granary. This granary was referred to during the hydraulic department at Arnatrong's. The patent ventilating Granary arrangement consisted of a perforated their running down the centre of each bin. This was provided with a movable stop of page, and, by adjusting the height of the first he most part of the granary and the granary was pulled down after a time. It is easy to understand that move the granary was pulled down after a time. It is easy to understand that Granary has the granary was pulled down after a time. It is easy to understand that Gran mot hard times, into which he are would not penetrate me of difficulty; and it may be said that it has not yet been solved. form into hard lumps, into which the air would not penetrate

As a matter of fact it is found more advantageous to air the grain by giving it a constitutional over the carrying bands

Prof. Hele Shaw's paper on his experimental engine and

alternative centre testing machine was one of great interest. The engine in question, which is described as a marine engine, though it has a large fly wheel, is, we believe, the most elaborate from an experimental point of view, yet made. The question has been raised whether it is not too elaborate, so that satisfactory results will not be reached on any one point. That is a problem which remains to be proved by facts, for the engine has only just been erected. It is 150 horsepower, and is of the ordinary vertical three-cylinder three-stage power, and is of the ordinary vertical three-cylinder three-stage compound type. The high pressure and intermediate cylinders have cylindrical valves, and the low pressure has a flat motion—namely, ordinary Stepheron lah, motion, for gear, and Hackworth gear. The cylinders are packeted at side and ends, and there are provious in the way of con-nections for working in every possible manner, i.e. cylinders all packeted, not packeted at all, or any out or tocylinders all jacketed, not jacketed at all, or any one or two picketed. Any combination of cylinders can be worked, or any one cylinder alone. In addition to this the cranks are adjustable on their shaft, so that any combination semicons that are at command would require years to work through. There are the usual measuring tanks and other apparatus for quantita-tive tests. An excellent suggestion was made by Frod Good-anna during the discussion. He proposed that arrangements should be made for testing the students knowledge by patting the rigge entry of the control of the control of the control of the through the control of the control of the control of the control of the through the control of the through the control of the control of the control of the control of the through the control of the contro nne engine into constitions not in accordance with proper design For instance, he would have valve rods or excentir rols of improper length, valves ill-set with improper lap or leaf, leaky valves and photons, and various other ills, to which engines are subject, purposely introduced He would also provide a means of passing water into the cylinders. He would then have this student take diagrams from the engine, and leave him to determine the cause of the defect by the appearance of the cards We hope Prof Goodman will be able to follow up this useful suggestion in his own laboratory at Leeds The alternative testing machine is a 100-ton single-lever machine of the Wicksteed type. The alteration in power is got by substi-tuting one julcium for another a few inches distant. The sanism by which this is done is ingenious, but the details

mecanarim by which this is done is ingenious, but the details would be difficill to explain without the aid of diagrams. The last paper read at the meeting was that of Mr. Leader Williams. The author commenced by saying that 464 million cubic yards had to be excavated in making the Mainchester Ship Canal, and as only 17,000 men and 200 horses have been used. there was evidently required a large power in the shape of there was evidently required a large power in the snape of mechanical appliances in order to get the work done in anything like reasonable time. Ninety seven steam excavators and eight steam dredgers of large power have been employed, and the spoil has in most cases been taken a distance of several miles. For this work, and for the general purposes of construction, 173 locomotives and 6300 trucks and waggons have been used. The railways laid for the purpose amount to 228 miles of single line. The rate of iant or the purpose amount to 225 mites of single line. The rate of execution has warred from three-quarters of a million to 1 million cube yards per month. There are also employed on the works 124 steem cranes, 129 nortable and other steam-engines, and 12 steam-pumps. The coal consumed by the engines is about 10,000 tons a month. These figures will give some idea of the heroic proportions upon which large constructive works. of the nerois proportions upon which raige constitutive was are carried out, and the capital required to start them. The whole plant of the Manchester Ship Canal has cost, we believe, close on a million sterling. The machines described in the

paper which were of greatest interest were the excavators. The chief of these is the now well-known "steam navvy," made by Ruston and Proctor, of Lincoln. It first came prominently into notice during the construction of the Albert Docks, and is looked on as a standard tool wherever large Docks, and is looked on as a standard fool wherever large excavating work is undertaken. It has the immense ad-vantage of being able to work in any kind of soil, even including sandstone rock, if not very hard. It is only in hard rock that blasting has to be done as an auxiliary The most interesting, or, perhaps, we should say the for the first time in connection with this work. These are on the same general principle as a floating ladder and bucket dredger of the common type. In place of the ladder and motive machinery being held by a floating bull, there is a small house mounted on wheels, and this runs on a line of rails on the summit of a bank. The ladder slopes outward from the side, summit of a bank. The tadder stopes outward from the side, reclining on the bank, which the buckets scrape away as they traverse, and deposit the spoil in waggons on the bank above. There are differences in detail between the French and German anere are distrements in detail between the French and German types, but in general principle they are allow The German machine appears to us the better designed, but Mr. Leader Williams says the French excavator is of more substantial construction. The weight of these machines is from 70 to 50 tons, and under favourable conditions they have been known to excavate the enormous bulk of 2400 cubic yards in one working day Mr Williams's paper was not discussed, which is a fact to be regretted by engineers, as the subject is one which requires ventilation, but time was running short After the usual votes of thanks, the sittings of the meeting were brought

We can only add a few words about the excursions On the Tuesday there was a lunch on hoard the big White Star liner the Majestic, for one section of the members, whilst others the Haystite, for one section of the memoers, whilst other-visited the grain warehouse, described by Mr. Shapton in his paper, and the new overhead railway, which has been designed by Mr. Greathead, the Engineer of the City and South London Railway, and which runs along the line of docks. This railway Railway, and which runs along the line of docks This railway is of steel and iron throughout, and possesses the novel ad so in seer and from infoughout, and possesses inc novel advantage of forming a water tight roof, under which the people of Liverpool will be able to walk on rainy days without getting wet In the evening there was a conversazione, which, of course, was the social feature of the meeting. On Wednesday afternoon the members visited the new engineering laboratories which have been added to University College, Liverpool, where the engine and testing machine described in Prof Hele-Shaw's paper were and testing machine described in Prof. Indee-Shaw's paper we examined. On I hursday one party visited the Mersey Docks, the Mersey Tunnel, and Laird Bros's hip yard and engine works the nersey tunner, and Laru Bros. Sup yard and engine works.
At the latter there are several interesting vessels in progress, including the big battle ship Noyal Oak, of 14,000 tons. Another
party went to Horwich, and saw the fine locomotive works which
have just been completed there by the Lancyshre and Yorkshire. have just been completed there by the Lank-value and Yorkshire Railway. These works have been beautifully planned and laid out under the superintendence of Mr. Aspinall. Although not so large as some other establishment of a similar kind, tury may be taken as a model of design. Mr. Aspinall. Although not so unique opportunity with a General of a similar kind, tury may accommissed experies on the model. Finally, the last day, was developed to the Mancheser Ship Canal, the members and extended the publishment of the members and extended the publishment of the source of the members that the members are some some some some some some that the members of the source of the source of the source that the source of the source of the source that the source of the source that the source of the source that the source the source that the source the source that the source the source the source that the source the source that the source the source the source that the source the source the source t being carried down the line of works in a special train, under the guidance of Mr. Leader Williams.

THE NEW GAS, CHLOROFLUORIDE OF PHOSPHORUS.

A S briefly announced in the report of the proceedings of the French Academy of Sciences, a note upon a new gaseous compound, containing phosphoray, fluoring, and chloime, has just been presented by M Mousain, on behalf of M Touless During the course of his work upon the fluorings of more of his work upon the fluorings of more was broad to the contract of the fluoring that the course of the cour prought in council with enfortne, the green colour of the latter at once disappeared, and there appeared to be formed a new and colourlets gas. The gas thus formed has been prepared in considerable quantity by M. Poulene, and its properties investigated. It appears to be directly formed by addition, according to the sample equationfor the trifluorate of phosphorus and chlorine are found to reach to a qual volumes, and the combination is attended by a contraction of one-half. The new gas may therefore be considered as phosphorus chlorofluorate, PCLFs, the chlorine derivative of phosphoryl and thiophosphoryl fluorate, PCFs and P.F. The most convenient mode of preparation is described as followed.

The court convenient mode of preparation is described as follow. Two flashes of equal expectly (thout 500 or 3 are taken, and filled respectively with phosphoras trifl sounds and allower they are connected together by a bent tube passing through the stoppers, and the flast containing the phosphoras triflatories are farther connected to the triple and the stoppers, and the flast containing the phosphoras triflatories to gradually displace at over into the chlorum. The two flasts being of equal capacity, it is evident that, when the whole of the triflatoride has thus been transferred, the reaction is completed, the green colour of the contents of the other flast disappears, and the remaining gas is almost pure chirocofiscioned in order to remove the last traces of chlorums, the gas is ready

for estimation.

Phosphorus chlorofluoride is a colouriess incombistible gas, possessing a powerfully urntung odour It is instantly absorbed and decomposed by water and by solution of alkaline or alkaline earthy hydrates A determination of alst supportunities and the solution of alkaline or alkaline earthy hydrates A determination of alst supportunities and the solution of alkaline or alkaline earthy hydrates A determination of alkaline or alkaline earthy hydrates and by supportunities and by the solution of alkaline pressures. It is dissocated at a temperature of 25°C into gaseous pentaficoride and solid pentachloride of phosphorus Phe induction sparse effects the same decomposition.

Sulphur reacts with phosphorus chloroflouride in a most insectuting manner. The reaction commences about the medium-

The induction spark effects the same decomposition. Sulphur reacts with phosphorus chlorofilourde in a most interesting manner. The reaction commences about the melting Sulphur reacts with phosphorus chlorofilourde and the melting and properly and the same of second thorophorphory florence, Esp., and here a most emphatic protest must be made against the manner in which many French chemist persistently genore the work of the war of the control of the co

and described as new by French author.

When phosphorus chloroflounde is passed over free phosphorus hested to 120°, it is decomposed with formation of phosphorus characteristics and the phosphorus characteristics and time when hested to about 180°, stated the gas with clead, and tim, when hested to about 180°, stated the gas with relating the phosphorus characteristics and time the phosphorus characteristics and the phosphorus characteristics and a chloride of the metal and guessou turbound of phosphorus. Hence, when purriying the gas from the last tuces of chlorine, creat, as agistiant burgs and to the perceptible amount of decom-

Water reacts in two stages with phosphorus chlorofluoride. When a little aqueous vapour is admitted into the vessel inclosing the gas, phosphoryl fluoride and hydrochloric acid are formed in accordance with the equation—

When passed into water, however, the gas is completely

1 Journ Chem Soc Irans, 1889, vol by p 305

NO. 1136, VOL. 44]

decomposed into phosphoric, hydrochloric, and hydrofluoric acids— PCl.F. + 4H.O = H.PO. + 2HCl + 3HF.

Ammonia gas reacts at the ordinary temperature with production of a white solid compound, readily soluble in water, which appears to be flaophosphamide, PF₈(NH₂),

hich appears to be flaophosphamide, $PF_3(NH_2)_2$, $PCl_2F_3 + 4NH_3 = PF_3(NH_2)_3 + 2NH_4Cl$,

Phosphoras chlorofluoride is absorbed by absolute alcohol with production of a compound possessing a penetrating odour, and which burns with a bright fluore bordered with green, and leaves a white residue of phosphoric acid. The nature of this compound has not wet been fully acceptanced.

a write residue of prosperors can't in a nature of this compound has not yet been fully ascertained.

These properties of phosphorus chlorofluoride indicate that the gas is much less suble than the pentalworlde, and that the two atoms of chlorine possess a mobility which renders their removal a matter of considerable each.

PROF MENDELEEFF ON THE VARIATION OF THE DENSITY OF WATER AT DIFFERENT TEMPERATURES.

THE Was Action of the District of the Xeenas Physical and Chemical Society (581). No 5) contains an amportant paper, by Prof. Mendeletelf, upon the variation of the density of water at different temperatures. In a work, published in 1884, and translated into English in the Journal of the Chemical Society, the Xussian Professor proposed the formula and the Xeenas and Tendesor proposed the formula to the person of liquids at a certain distance from the temperatures at which they change their state, and within the limits of accuracy attained in the present determinations. But he re-formula and he now proposed the formula.

$$S_t = 1 - \frac{(t-4)^2}{(A+t)(B-t)C'}$$

which embodies with misconserver, all that use the common about changes are set to expend the common about changes are set to the common about commo

from zero, and even superior to 100°. After confirming the above by a few example, Prof Mendelecti midactise the faint relations between his new formula for water and the general law of the expansion of liquids, by explaining the way in which he arrived at his new formula. It points out, moreover, that under the present state of the determinations of the density of water from the constant A, B, and C, in the above formula, and that provisionally, and especially for temperatures between 0° and 40°, they may be taken as follows —A = 947.0 Prof Mendelectff then goes on briefly to analyze the various corrections which ought to be taken into account in the deter-

Prof Mendeleeff then goes on breely to analyze the various corrections which ongly to be taken into account in the determinance, the expansion of solids, and the measurements of teamers, the expansion of solids, and the measurements of teamers, the expansion of solids, and the measurements of teamers are solid to the solid teamers are solid to the error of the best determinations of densities attains several the errors of the best determinations of densities attains several manage transcribed attempts at improving the current figures of densities by sutroducing into them several corrections, Prof. densities by support to the several corrections of the several corrections, Prof. densities by support to the several corrections, Pro

The averages of the volumes of water derived from the original

figures (Table I.), at temperatures from -5° to $+100^{\circ}$, taking the volume at 4° equal to 1,000,000, and the pressure being equal to one atmosphere, appear as followed, in the documen (V_s) of the subjoined table. They are followed, in the third column, by the volumes as calculated from Prof. Mendeleeff's new formula 1-

,	٧٨	V, = 1 S, catculated from the formula	dV dt for 1°	dV dp for 1 atmo sphere	Possible errors of the present deter- minations
- š	1 000 662	1 000 676	~ 157	- 52	∓ 29
ő	1 000 122	1 000 127	~ 65	- 50	I 12
+5	1 000 008	800 000 1	+ 15	- 48	± 3
10	1 000 263	1 000 262	+ 85	- 47	± 15
15	1 000 847	1 000 849	+148	- 46	± 26
20	1 001 733	1 001 731	+ 204	~45	± 35
25	1 002 871	1 002 880	+ 254	- 44	± 43
30	1 004 248	1 004 276	+ 302	- 43	± 49
40	1 007 700	1 007 725	+3:6	-41	± 59
50 60	1011933	1011967	+461	- 40	± 67
	1016915	1016926	+ 530	- 39	± 75
7º	1022513	1 022 549	+ 595	- 40	± 85
	1 028 849	1028811	+656	41	± 98
90	1 035 719	1 0 3 5 6 9 2	+719	- 42	±118
100	1 043 180	1 043 194	+ 781	-44	±145

Finally, a third table is given, being the result of the calculation made by taking

$$S = I - \frac{(\ell - 4)^2}{IOOCO(\ell)},$$

 $\phi(t) = 128.78 + 1.158t - 0.0019t^3$

and $1000\phi(t) = 190(94 to + t)(70351 - t),$ and extending the calculation to + 200° and - 10° The most important values of $\frac{ds}{dt}$ are given in the fourth column of the subjoined table , so, also, the approximate values of $\frac{ds}{d\hat{p}}$, which are "but a first rough approximation," to show the importance of pressure in the determinations of volumes of water —

₽° C.	Calculated densities, S _t	Possible error of present measurements (in 1,000,000th parts)	Denved dijdt for 1° C (in 1,000,000th parts).	Denved da/dy for 1 atmosphere (in 1,000,000th parts)	Numerical values of $\varphi(I)$	Calculated V,
- 10	0 998 281	Ŧ 49	+ 264	+54	114'01	1 001 722
5	999 325	Ŧ 20	+ 157	52	119794	000 676
ő	999 873	¥ 12	+ 65	50	125 78	000 127
+ 5	999 992	Ŧ 12 ± 3	- 15	48	131 52	800 000
10	999 738	± 15	- 85	47	137 17	000 262
15	999 152	± 26	- 148	46	142'72	000 849
20	998 272	± 35	- 203	45	148 18	001 731
25	997 128	± 43	- 254	44	153 54	002 880
30	995 743	± 49	- 299	43	158 81	004 276
40	992 334	± 53	- 38o	+41	169 06	1 007 725
50	988 174	65	- 450	40	178 93	OII 967
60	983 356	72	- 512	39	188 42	016 926
70 80	977 948	80	- 569	39	197'53	022 549
	971 996	92	- 621	40	206 26	028 811
90	965 537	109	- 670	41	214 61	035 692
100	958 595	133	- 718	42	222 58	043 194
I 20	943 314	±600	- 810	+43	237.38	1.000 003
140	926 211	650	- 901	48	250 66	079 667
160	907 263	700	- 995	55 64	262'42	102 216
180	886 393	750	- 1093		272.66	128 167
200	863 473	800	1200	73	281.38	158 114
	ł		1	ł	1)

In conclusion, Prof Mendeleeff repeats that he proposes as ties of water, because the former determinations were made on assumptions (permanency of the coefficient of the expansion of glass and mercury, and no notice being taken of pressure) which can no longer be maintained. If new measurements conglass and molecules which can no longer be maintained. If new measurements confirm the formula, or lead to a more correct one, we shall be better able to understand the laws of the expansion of all liquids, better able to understand the laws of the expansion of all liquids. and therefore of gases as well "In the case of water," he says, "we have begun to understand more clearly the influence of heat upon densities and volumes, and I believe that with the of the influence of heating upon matter"

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

Oxford -The examiners in the Final Classical Schools

OVFORD—The examiners in the Final Classical Schools saved the Class List on Wedinerday week, completing the results of like examinations held in Trinity Term. The summer meeting of Extension students commenced on Firstay last, when Mr. Frederic Harrison, M.A. Wadham College, delivered the inaugural lecture. The propalanty of the movement is proved not only by the continual increase in the number of Students who avail themselves of the advantages. offered by this system of education, but by the interest which foreign Governments are taking in the development of the plan The French Government have sent two special commissioners to report on the prospects and condition of the University Extension movement, and a large number of the representatives of the American University Extensionists are now in Oxford

The number of students attending the various lectures is The number of students attending the various lectures in generic than on any previous occasion, more than 1 time having generic than on any previous occasion, more than 1 time having 500. A more rajed growth and a still greater measure of success attending the work may be attended from the fact that various County. Councils, finding themselves in possession of linds which they propose to derote to the purpose, of technical matrixion, are availing titemselves of the machinery of the Cunverty Extension system to accomplish this destructive description.

SCIENTIFIC SERIALS

In the Hotanical Gazette for June, Mr T. Holm contributes a study of some anatomical characters of North American grasses sumy on some anatomical characters of North American grasses In a paper entitled "On the Relation between Insects and the Forms and Characters of Flowers," Mr T Mechan epitomices his views on fertilization opposed to the current theory, via, that the part played by insects in the fertilization of flowers has that the pair pulyed by insects in the ferringation of flowers has been greatly exaggerated, that flowers do not abhor cross-polleu, and that all annuals can self-fertilize when cross-fertilization fails, annuals in almost all cases having every flower fertile

THE most important paper in the Journal of Botany for July is the commencement of a detailed account of the Alga of the Clyde sea area, by Mr George Murray, Secretary to the Com-mittee for the Exploration of the Marine Fiora of the West of mittee for the Exploration of the Ment of Socialmal This is prefaced by an account of the physical Socialmal This is prefaced by an account of the physical thin is the commencement of a hand list of the Algae, by Mr. E. A. I. Batters. The Rev. H. G. Jameson concludes his key to the genera and species of British mosses, which it is hoped may be published in a separate form, and Mr. George Murray sinks Hooker's genus of sea-weeds Cladothele in Stretyonphon

SOCIETIES AND ACADEMIES.

Academy of Sciences, July 27 —M Duchartre in the chair — Proofs that Assa and America have beet connected in recent tunes, by M. Emile Blanchard. In this paper the author points out certain species of Asiate fanna and flora which are found in North America, as, in the preceding one, he indicated the representatives of European fauna and flora which occur in the same continent. Without making an extensive caumentation of the

different species, the facts brought forward give considerable support to the idea that Burope, Asia, and America have been sure to the idea that Burope, Asia, and America have been savaris from St. Columbo, by M. Albert Gandy. This is a decorption of an Jehhypaurus exhibited at the Paris Exhibition of 1859. It is proposed to name the fossil Jethypaurus buy-origin discovered in gold withings from the environ of Bere-sowsk, by MM. Daubres and Stanlain Memour. The specimens camined weighted respectively 11% grams and 72 grams, and metal is very magnetic, but mindirest no polanty. Its density metal is very magnetic, but manifests no polarity metal is very magnetic, but manifests no polarity. Its density is 7.59. When treated with an acid it is sensibly attacked, but does not show the Widmanstatten figures as is the case when acid is applied to a clean face of meteoritic iron fact and the absence of nickel leads the authors to conclude that sact and the absence or meker leads the authors to conscue that the iron is truly native. About one per cent of platinum is present—On the volatility of nickel under the influence of hydrochioric acid, by M. P. Schutzenberger. When dry hydrogen is passed over pure anhydrous nickel chloride at a red heat, it may be shown that the hydrochloric acid gas which comes off from the tube in which the reduction occurs contains a sensible amount of metal in the form of a volatile product.

The same result is obtained if, instead of reducing nickel chloride The same result is obtained if, instead of reducing mickel chloride by hydrogen, finely divided mickel is nacted on by dry hydro-you have a supposed of the control of the constitution. Note on a projected Observatory on Mont Hane, by M I Isansen—On the retardation of Jaminous impressions, by M Isansen—On the retardation of pressions of the Endouse geometrical representation and formula expressing the law of the passage of pericet gases through ordices, by M. Henri Partetty—On the dentaties of oxygen, hydrogen, and introgen, oxygen oxygen to 2005, introgen 4 4720. Now the dentaties of oxygen oxygen o 1050, nitrogen 4 9720. From the densities of oxygen oxygen o 1050, nitrogen 4 9720. From the densities of oxygen and nitrogen the percentage proportion of the former element in as is found to be 33 335 by weight and 21 026 by volume. The atomic weight of nitrogen deduced from these results vs 13 99, and that of oxygen 15 905.—Remarks on the transport of metallic tron and nickel by carbon monoxide, by N Julies Garmer. Some observations of the character of the flames issuing from furnaces. in which these metals are being reduced are shown to be easily in which these metals are noting reduced are shown to be easily explained in the light of recent work on iron and nickel carbonyls.—Action of water on the basic salts of copper, by MM. G. Rousteau and G. Tite. Certain borates and oxychloride of antimony are transformed to oxides by the prolonged. action of water at a sufficiently high temperature Similarly, by heating copper nitrate, brochantite, and atacamite with water in sealed tubes they have been reduced to oxides Libethenite has been experimented upon, but has resisted the transformation has been experimented upon, but has resisted the transformation even when kept in the presence of water for three days at a temperature of 275°C—On an actual mode of formation of mineral sulphide, by N E Chanda—Researches on thallum, by MM C Lepterre and M Lachaud Thallum obronastic base the presence of the control of the control of the base prepared by acting on thallum sulphate with potential that the control of the control of the control of the On patterns of the control of the heat of combustion of parabanic acid is found to be 212 7 cal, of oxaluric acid 211 cal. Hence the heats of formation have been calculated, 139'2 cal. and 209'9 cal. The heat of solution of parahamic acid at 20° and with a concentration of the mol per litre is - 5 t cal. The formation from oxalic acid of its ureide. parabanic acid, gives + 2.2 cal and of its uramic acid, oxaluric acid, + 2.5 cal. The formation of the ureides thus gives only a feeble heat-liberation. Each of these acids dissolved in a large excess of potash yields the neutral potassium oxalate Potassium oxalurate has been prepared by dissolving the acid in its equioxaltrate has been prepared by dissorting the account at valent of potash and evaporating. Fine prismatic needles are obtained, differing from the salts of Menschatkin and Strecker The heat of neutralization of oxaltric acid is 30 2 cal., as against The heat of neutralization or oxamine was 15 to 2 cm., as again, and 42 cal for oxahe acid,—The transformation of galle need and tannin into benzoe acid, by M. Ch. Er. Guignet.—On the polymeric acids of ricinologic acid, by M. Scheuer Kestner—On the fermentation of bread, by M. Léon Boutroux. During an examination of the conditions essemial for the fermentation an examination of the conditions essential for the fermentation of breaf, the subtroop has obtained in species of years and three dispersity and Educational Intelligence 335 species of bacters. The parts played by each of these organisms is scientific Senals and described, and the conclusions in shally drawn that the fer-discribetes and Academics 335 mentation of bread consists essentially of a normal alcoholic Books, Pamphiets, and Serials Received 335 organisms.

fermentation of sugar pre-existing in the flour, and that only the yeast producing alcoholic fermentations are necessary; the ordinarily co-existing alteration of gluten is a subsidiary and unessential action due to some of the bacteria present.—On a therenogene substance murine, by M. Paul Binet.—On the transformation of carboxy hermoglobus lato methomoglobis, and a new process of examination for carbon monotode in the blood, by MM. H. Bertin-Sans and J. Motessier.—On a new apparatus for measuring muscular power, by M. N. Grihant —Measure of the muscular power of animals under the action of certain powens, by MM. Ordnart and C. Quanquasid —On the concurrence of the C. A. Anglas of the continue of the C. A. Anglas of the C. A. Anglas of the continue of the C. A. Anglas of the values obtained by calculation, by M. Drzewicki, —Analysis by hotographing objects in rapid monoi, the author has succeeded in portraying the movements of them one of chronic objects in rapid monoi, the author has succeeded in portraying the movements of the hip during speech, and when the hobographing objects in rapid monoi, the author has succeeded in portraying the movements of the hip during speech, and when the hobographic results in gest un as a 20070000—Relation a new process of examination for carbon monoxide in the blood. when the photographic results are spun in a zootrope -Relation between oscillations of the retina and certain entoptic phenomena. netween oscillations of the retina and certain entoptic phenomena, by M. A. Charpentier — The nanny-goal is not refractory to tuberculosis, by M. G. Colin.—Researches on the pathogenic microbes in muds from the Dead Sea, by M. L. Lortet, —On the excretory apparatus of Candalas, and on the renal secretion. the exercity apparatus of cantings, and on the canal and of Crustaces, by M P Marchal—On the nervous system of Monocotylide, by M G Saint Remy—Contribution to the natural history of a cochineal, Rhivacus falcifer, Kunck, disnatural hydory of a cochineal, Natureus faicifer, Kunck, dis-covered in the greenhouses of the Museum and hying on the roots of the vine in Algeria, by MM Kunckel d'Herculais and Frédéric Salba—On specific assimilation in Umbelliferæ, by M Genean de l'amarière—Pocument relative to the trajectory of the Ensishein meteorite of 1492, by Prof H. A Newton On the comon and transport by torrential rivers having glacler affluents, by MM L. Duparc and B Baeff

BOOKS, PAMPHLETS, and SERIALS RECEIVED. BOOKS, PAMPHLETS, and SEKIALS KINCELVELY.
Comman Production: E. McLernau (Cheego, Losoubus, 1 has Armilley.
Comman Production: E. McLernau (Cheego, Losoubus, 1 has Armilley.
Raunful, 1 hoo of J. Symones and H. S. Wallit (handred)—Expension
flameaus, Notes on set Origin and Mithod of Symol. Jr. R. Saiety (Loss
red canadation, vol. 1, and edition. Dr. A. Weilmann, edited by E. B.
Poulton S. Scholland, and A. 1 hypley (Loften, Lernadon Presul.)

CONTENTS.	PAGI
A Physiciat on Colour-Vision By H H	31;
Positive Science and the Sphinx, By C Ll. M.	31
Analytical Methods of Agricultural Chemista	317
Seological Rambles round about London, By	, 3.,
T. G. B.	317
Our Book Shelf	3.,
"Katalog der Bibliothek der Deutschen Seewarte zu	
Hamburg"	218
"Scientific Results of the Second Yarkand Mission"	318
Airy "Popular Astronomy"	319
Letters to the Editor -	3.
Force and Determinism -Prof C. Lloyd Morgan;	
Edward T Dixon, D Wetterhan, Rev T.	
Travers Sherlock	310
Technical Education for Farmers, Farriers, and	3*5
Engine-Drivers -John L Winter	320
The Eruption of Vesuvius of June 7, 1891 (Illus-	320
trated) By Dr. H. J. Johnston-Lavis	320
The Production of Musical Notes from Non-	340
Musical Sands By Cecil Carus-Wilson	332
Notes	323
Our Astronomical Column:-	343
Researches on the Mean Density of the Earth	327
Parallax of P Urse Majoris	327
The Progress of Medicine. By Dr. T. Lauder	. 341
Brunton, F.R S.	327
The Institution of Mechanical Engineers	
The New Gas, Chloroffuoride of Phosphorus, By	332
A. E. Tutton	
Prof Mendeleeff on the Variation of the Density of	333
Water at Different Temperatures	
University and Educational Intelligence	334
Scientific Sensis	335
Inclusion and Assets at the I	335
ocieties and Academies	. 335

THURSDAY, AUGUST 13, 1891.

THE INTERNATIONAL CONGRESS OF HYGIENE AND DEMOGRAPHY

THIS Congress, the work of which we refer to in another column, which is now in full swing, promises to be one of the most important meetings of the kind that has ever been held not only in point of numbers, but also on account of the far reaching results likely to accrue from it

A remarkable combination of circumstances has contributed to its success. In the first place, it is held in the country which has been the pioneer of sanitary work; and then it has the patronage of Her Majesty the Oueen, who, it is well known, takes a deep personal interest in its success; and has as its President, not merely in an honorary sense, His Royal Highness the Prince of Wales, who presided and gave an admirable address of welcome at the splendid opening meeting on Monday in St James's Hall

This is the seventh of a series of similar Congresses which have been held in various parts of Europe, and one is tempted to ask what they have accomplished An answer is at once forthcoming The all-important question of quarantine has been discussed at several of these Congresses. Not to go farther back than the Congress at The Hague, held in 1884, we find, from the excellent reports issued by the editors of the Lancet, that then the feeling in Europe was so strongly opposed to the English views as to the mutility of quarantine and the superiority of our method of medical inspection, that the English delegate was not even allowed to explain the English position in the matter, but the discussion was peremptorily close i, on the ground that the subject had been sufficiently discussed on the previous day At the Vienna Congress, in 1887, quarantine was again discussed under the subject of cholera; and the veteran Pettenkoffer told the members of various countries present that they had only to follow the example of England, in looking after their systems of water-supply and sewerage, and in isolating cases of infectious disease, and they would be no more afraid of cholera than the English were, even with their continual communication with India, the home of that disease, and would have no need of quarantine, with all its vexatious and ineffective restrictions, and all its unnecessary interference with commerce. Now, Continental opinion is almost entirely on our side, and it is doubtful whether there will be any serious discussion on the

But there are many other subjects with which the Congress will interest itself, and about which such an interchange of views as can only be obtained at an International Congress must be of the greatest benefit The whole subject of bacteriology has grown up within the last few years, and one of the most important and best attended Sections of the Congress is devoted to it, many of the highest authorities on this subject having been attracted here to take past in the discussion under the presidency of Sir Joseph Lister. The abnormal prevalence of diphtheria, not only in our own large towns,

but also in those of other parts of Europe and in America. in many cities of which, especially in the Western States of North America, it has become a veritable plague, is likely to occasion an important discussion in Section I., under the presidency of Sir Joseph Fayrer, The mention of his name leads us to observe that India is well to the front in this Congress, for not only have a number of delegates been sent by her Provinces and Native States, but they have also largely contributed to the funds of the Congress

Influenza, too, our new plague, about which we seem to know so little, might be discussed, as to its mode of spread and methods of prevention, with great advantage at a meeting where so much experience from all parts of the world is focussed

An especial feature in this Congress is, as might be expected in England, the prominence which is given to engineering and architecture in connection with hygiene. there being two separate Sections devoted to these branches of the subject

The division of demography, too, which has been so much talked about on account of its name, which was up to the present time unfamiliar to Linglish ears, and which has been defined by some way as "the art of drawing the public," has attracted, under the presidency of Mr Francis Galton, many of the most eminent statisticians of Europe. whose discussions cannot fail to promote the attainment of more uniformity in the methods of statistical inquiries

This is an age of Congresses, and if they are, as it is universally agree! that they are, of any use at all, it is self-evident that the most useful and the most important are the international ones

A LIFE OF DARWIN

Charles Darwin His Life and Work By Charles

Frederick Holder (New York and London G P Putnam's Sons, 1891) BETWEEN the voluminous "Life and Letters" of

his father, by Prof Francis Darwin, and the brief epitome of Darwin's work, by Mr G T Bettany, published in 1887 in the "Great Writers" series, there has hitherto been a gap which has only been partially filled by such books as Grant Allen's "Charles Darwin" in the series of "English Worthies" In the first of the works mentioned, our great naturalist is chiefly allowed to speak for himself, while in the second we have a digest of his scientific achievements. Although it has been generally considered that the life of Darwin from the time of the return of the Beagle was too uneventful to make an interesting biography, we have always been of opinion that there existed sufficient material for a popular " Life" of the very greatest interest provided that this material could be skilfully and judiciously worked The work under notice supplies this want, and

American and English readers are now provided with a biography which is both entertaining and accurate

Of course the material out of which Mr. Holder has woven his story is for the most part to be found in Darwin's own writings, or in the "Life and Letters," and readers who turn to the pages of this book with the hope of finding new matter may be disappointed. But the very circumstance that out of the familiar records of the voyage of the Beagle, and the later writings of Darwin. the author has been enabled to construct such a very readable volume, is the best tribute to his skill

The task which Mr. Holder took up was by no means an easy one: the difficulty which he had to confront did not arise from paucity of material, but from a superabundance of records, owing to the very complete account of his own travels and observations which Darwin has bequeathed to us. To extract the salient points from these records, and to dress them up in the writer's own language, was a labour requiring considerable literary ability Mr Holder has shown that he was well qualified for the undertaking, and it is refreshing-after the "Summary of the Darwinian Theory," and similar productions to which we have recently been treated in this country-to find that an American naturalist is able to write an account of Darwin and his work in language expressing his own ideas on the subject, instead of stringing together a lot of disconnected quotations from Darwin's writings. Not the least praiseworthy feature of the book is the comparatively small number of extracts from the writings of his hero, the author is wise enough to recognize the fact that most reading naturalists may be supposed to be familiar with the text of the "Naturalist's Voyage," the "Origin of Species," and other Darwinian classics

The present volume is one of the "Leaders in Science" series, published by the firm of Putnam's Sons The author says in the preface -

"When the publishers proposed to me the subject of the present volume, a life of Charles Daiwin for American and English readers, I was particularly gratified with the suggestion that the work should be adapted to young readers as well as old It has always seemed to me that the life of Charles Darwin was one eminently fitted to be held up as an example to the youth of all lands. He stood as the central figure in the field of natural science in this century, and while it is yet too early to present his life with any approximation of its results upon the thought of the future, it is apparent to everyone that his influence upon the intellectual growth of the country, and upon biological science in particular, has been marked and epoch-making

"In the preparation of the work I have not attempted an analytical dissertation upon Darwin's life-work, neither have I discussed his theories or their possible effect upon the scientific world, but have simply presented the story of his life, that of one of the greatest naturalists of the age, a life of singular purity, the life of a man who, in loftiness of purpose and the accomplishment of grand results, was the centre of observation in his time, revered and honoured, yet maligned and attacked as few

Having thus defined his object, the author proceeds to narrate his story, beginning with the boy Darwin, passing on to his Cambridge career, and then leading us through the scenes of his wanderings as naturalist to the Beagle. The major portion of the volume (twelve out of the twenty chapters) is thus pleasantly filled up, all the little personal incidents which give colour to the individuality of the man are skilfully brought in, and here and there the author interposes observations of his own which help to throw light on the questions discussed and the facts recorded by Darwin. Having in view the taste of his younger readers, a number of full-page illustrations have been introduced, some being reproduced from author mentions the views of Bonnet, the doctrines of

Spry's "Voyage of the Challenger," others from Gosse's "Romance of Natural History," others from Brehm's "Natural History," from Figurer's works, and from the Century Magazine. Many of the illustrations are new, the frontispiece, representing Darwin in his garden with the squirrels running up him, being well worthy of notice

The working period of Darwin's life from the return of the Bearle to his death is dealt with in three chapters, in the course of which the author relates the history of the "Origin of Species," and the impetus given to the publication of that work by the independent discovery of the principle of natural selection by "Alfred Russel Wallace, a young Welsh naturalist, who was then travelling in the Malay country" This incident is of course familiar to all, but as an old story retold by a transatlantic admirer of Darwin it reads even now with the charm of freshness. The later works are referred to in chronological order, and in a succeeding chapter we have a catalogue of the honours conferred upon Darwin during his life The seventeenth chapter contains an account of the Darwin family, beginning with William Darwin, of Marton, near Gainsborough, in 1500, and concluding with Erasmus, elder brother of Charles Darwin, the friend of Carlyle, who was described by the latter in his "Reminiscences," and whose amiable character was more fully portrayed by Miss Julia Wedgwood in the Spectator in 1881 The latter description from the pen of Miss Wedgwood is given by Mr Holder in extenso

The narrative, as such, ends with the death of Darwin in 1882, and the reader will turn with renewed interest to the eighteenth and nineteenth chapters, containing Mr. Holder's account of the Darwinian theory The principles of this theory are fairly well expounded, considering the small amount of space which has been devoted to them Natural selection is illustrated by a happily chosen and original example from the animal kingdom, viz. the adaptive coloration of the fauna of the Sargasso Sea Another illustration of the principle is drawn from the vegetable world, viz. the evolution of a hairy seed adapted for acrial transport. The questions of geological time and the paleontological evidences of organic evolution are also touched upon, and here we think the author might have used more judgment. The formation of the chalk, for example, is not quite satisfactorily given, and the statement that the chalk cliffs of Dover have been elevated "by some convulsion of nature" (p. 185) will jar upon the geological susceptibilities of his readers. In a work intended for popular reading it would also have been safer to avoid any esumate of the time required for the denudation of the Weald, the more especially as Darwin himself admitted the unsoundness of such estimates by omitting this section in the later editions of the "Origin." The ancestry of the horse, and Prof. Marsh's discovery of the Odontornithes, are well brought in in connection with the palæontological evidence. We may point out in passing that the diagram illustrating the evolution of the horse, which fronts p. 62, is referred to both on pp. 189 and 190 as "the accompanying diagram," which is obviously an oversight.

In tracing the history of pre-Darwinian evolution, the

Thales and Anaxagoras, the speculations of Leibnitz, De Maillet, Wright, Lambert, Herschel, and La Place of Buffon he says.—

"Buffon was the naturalist of the day in the time of Louis XV and Louis XVI,"—a period somewhat famous for the restrictions which were placed upon men, and the demunications with which new and advanced ideas were received. Thus advanced thinkers found that their theories in many instances, instead of leading them on to fame, but oneed the doors of the Bastile.

"It is not improbable that Buffon was in accord with the feeling of the time, as while his great discursive work -'Histoire Naturelle,' of 1749-88 -- fully outlines the theory of evolution, in which he was a believer, it is done in an ironical, partly satirical manner, so that he could, if attacked, retreat by claiming that it was a satire on the advanced scientific thought of the time, he was ready to believe that from a single unit in the beginning might have descended all the various forms of existing animal and plant life. It is curious to note that this pioneer evolutionist suddenly corrects himself and says no: it is certain from revelation that every species was directly created by a separate fiat ' Wc may suspect that this secession from a position so broadly taken was forced upon the evolutionist. Perhaps the clergy gave him close and suggestive attention, and he was offered the offended orthodoxy Be this as it may, Buffon was one of the early delineators of the modern theory of evolution, and despite his piculiar attitude, history accords him this recognition

The works of Wolff, of Goethe, Geoffroy St. Hilaure Oken, Pander, Yon Baer, Shidheden and Schwann, Von Mohl and Max Schultze, Lord Monboddo and Erasmus Darwin, are all referred to in often order, and a well-bestowed paragraph of praise is given to Lumarck Letter writers, such as Robert Chambers, Von Himboldt, Owen, Asa Caray, Herbert Spencer, and Youmans, bring us down to the both of modern Darwinism

To English readers the last (twentieth, but erroneously headed eighteenth) chapter will be one of the most interesting It is entitled "The Darwin Memorial," and contains a series of addresses by American men of science, delivered at a special memorial meeting of the Biological Society of Washington soon after the death of the illustrious naturalist in 1882. The address of Dr. Theodore Gill, of the Smithsonian Institution, is a masterpiece of eloquence, treating of "The Doctrine of Darwin," and contrasting the doctrines of special creation and evolution The address by William Dall, of the United States National Museum, is equally cloquent, and treats of Darwin in the form of a biographical sketch. Dr. John Powell, the Director of the United States Geological Survey, follows with an admirable address on "Darwin's Contributions to Philosophy." We cannot refrain from transcribing some of his remarks.

"But Darwin's investigations have not ended research or completed philosophy. He brought scientific men to the frontiers of truth, and showed them a path across the border. Yet more than this be did. He pointed out one time philosophers talked about deductive methods and inductive methods. Darwin has taught us that both are fruitless. . . By inductive methods, men are to collect facts, unbiased by opinions or preconceived theories. They are to gather the facts, put them together, arrange railingtions, But there are facts and facts—facts with

value, and facts without value. The indiscriminate gathering of facts leads to no important discoveries. Men might devote themselves to counting the leaves on the trees, the blades of grass in the meadows, the grains of sand on the sea-shore, they might weigh each one and measure each one, and go on collecting such facts until libraries were filled and the minds of men buried under their weight, and no addition would be made to philosophy thereby I here must be some method of selecting. some method of determining what facts are valuable and what facts are trivial The fool collects facts, the wise man selects them Amid the multiplicity of facts in the universe, how does the wise man choose for his use? The tiue scientific man walks not at random through the world, making notes of what he sees, he chooses some narrow field of investigation. always suggested by some hypothesis—some supposition of what he may discover lie may find that his hypothesis is wrong, and discover something else, but without an hypothesis he discovers nothing Working hypotheses are the instruments with which scientific men select facts By them, reason and imagination are conjoined, and all the powers of the mind employed in research "

The succeeding additess, by Dr C V Roley, gives an account of Darwin Sentonological work, and comprises a graphic description of the naturalist in his home, drawn from personal reminiscences of a visit to Down Dr Lester Ward follows with his address on "Darwin as a Botanist," in the course of which he discusses, among other points, the betring of Darwin's researches on the power of moment in plants on the great question wrapped up in the expression "tendency to vary" Dr Frank Baker contributes the next addless, on the expression of the emotions, and in this we again meet with a spirited advocacy of the Darwinnan method —

"But not as a fact-gatherer do we find him greatest Many others have struggled with an-like toll to annas piles of facts, which, like the ant-heap, remain but sand after ill. Darwin brings to his wook as informing spirit, the genus of scientific hypothesis. Hreithed upon by this spirit, the dry bones of fact coune together. "bune to his bone, 'the sinews and the flesh come upon them, they became alive about the state of the state

A Darwinian bibliography, by Frederick W. True, the Libratism of the United States, National Misseum, and an appendix giving a list of Darwin's works, conclude a volume of which enough has been said to commend it to all readers, whether youthful or adult, and which we on this side of the Atlantic cannot but appreciate as a most inspiriting pretire of the life and work of the man who, of all others, has helped to emblacion our country's fame on the screnific second of the numberenth century.

R MLLDOIA

PINES AND FIRE OF JAPAN

Monographie der Abietineen des Japanischen Reiches. Bearbeitet von Dr Heinrich Mayr Mit 7 Coloriten Tafeln. (Munchen M Nieger'sche Universitäts Buchbandlung, 1890)

FROM the time of Kaempfer and that of Thunberg to our own day, the Japanese Conifers have been the objects of special predilection on the part of botanists.

Juccanni figured and described several that had been collected by Sebold, Lndley, Andrew Murray, Maximowice, Franchet, and others, contributed greatly to the elucidation and delimitation of the several species Robert Fortune, John Gould Vertch, and Charles Marses Introduced many to our gardens. Horticulure has, indeed, rendered great service in this matter. The trees in question are valuable for ornamental purposes, and potentially as timber trees. The consequence of this is that collectors have accumulated specumens in large that collectors have accumulated specumens in large moreover, supplied our insergemen with seed, so that young plants are now numerous in our nurseries and plantations.

The study of the seedling plants, in their progress from the seed-bed towards maturity, has afforded valuable evidence concerning the morphology of the group and its probable genealogy, its filiation and classification Cultivation has, for instance, shown that many of the very curfous forms known under the name of Reinso spora are, in reality, stages of growth of one, or at least of a few, species of Thuya, of Cupressus, or of Junperus, so that the so-called genus is purely ficitious. In hik manner Abust hifids and Abus, forma have been proved to belong to one and the same species

To fill up the gaps in our knowledge, and to correct errors arising from inadequate or imperfect material, it was necessary that the trees should be studied by a trained observer in the forests themselves This was the more necessary as, to a large extent, our knowledge has been derived from plants cultivated by the Japanese and in some cases, not a little distorted in the process earlier botanists had little or no opportunities of studying the native flora for themselves Even Fortune was largely dependent on the Japanese nurserymen John Veitch collected for himself on Fusi-yama, and Maries penetrated even to the forests of Yesso Dr Mayr, the latest writer on these plants, has enjoyed opportunities denied to his predecessors. After a distinguished career in Munich, Dr. Mayr proceeded to the United States, visiting the forests in all parts of the Union, and producing, as a result, a work which the best judges speak of in terms of high appreciation. Subsequently, our author visited Japan to organize the Forest Department, and fill the office of Professor of Forestry in the Imperial University of Tokio In the execution of his duties Dr Mayr travelled through the various provinces, and derived much information from the native foresters. One result is before us in the shape of a volume, printed in German at Tokio, and illustrated with seven coloured plates. The group specially studied by Dr. Mayr is remarkable for the relatively large number of endemic species Thus, Dr Mayr enumerates six species of Abies, all of which are peculiar to the Japanese islands. Five species of Picea are nearly as much restricted in geographical area. Tsuga, a genus represented in both the Northeastern and the North-western States of America, as well as in the Himalayas, has two species peculiar to Japan The genus Larix, which also has a wide distribution in the northern hemisphere, has two species native to Japan, and not extending far beyond its limits. Six species of Pinus are enumerated by Dr Mayr, and these also are almost exclusively Japanese, though some are found on the mainland adjoining.

The Japanese islands, then, form a centre of distribution of a group of species of a distinct character, differing markedly from a similar group of Chinese nativity, but approximating to the Californian and to the East American conferous floras, and having representatives in other parts of Northern Asia and of Europe The distinct character of the Japanese Considers and their relationships are even more prominently brought into view when the other tribes of Confeis sare considered. Dr. Mayr confines himself, however, to the Abietineze, and we must here follow his example; in the hope that on another occasion we may be able to accompany him also through the other tribes.

In speaking of the distribution of these plants, Dr Mayr alludes (1) to the tropical zone in which the genus Podocarpus is represented, but which does not specially concern us now. (2) to a sub-tropical zone in which are other two species of Podocarpus, as well as Pinus Thunbergu, which extends round the coast of all the islands, and less frequently Pinus densiflora. (3) a region of deciduous trees, such as chestnuts in the south or at the base of the mountains, or beeches and birches to the northward or at higher altitudes. Here grow especially the Cryptomeria, the various species of Chamacoparis, Thuyopsis, and Sciadopitys (4) The fourth zone, that of firs and spruces, occupies the high mountains in the centre of the Island Here are found Abies Vestchis, Puca bicolor, P Hondoenius, and Larix leptolepis, which are peculiar to the main island, together with A Mariesi, A sachalmensis, Picea araneusis, and P. Glehm, which extend northward, some even as far as the Sachalin and Kurile Islands Tsuga diversifolia occurs from the region of the beech upwards to the Alpine cone (5) The fifth, or Alpine region, also designated that of the Alpine pines, includes forms such as Pinus pumila, which is allied to the Swiss P Cembra We can only indicate these regions, as the discussion of their climatal features and plant population turns mainly upon plants different from those which form the staple of Dr Mayr's present treatise

Passing into detail, Dr. Mayr proceeds to describe each species separately, devoting much space to hierary references, Japanese as well as European, and giving a description of the main peculiarities of the tree from an economic as well as from a botanical aspect.

A few new species are indicated, of the value of which we can hardly form a trustworthy opinion in the absence of authentic specimens. We venture, however, to doubt whether Abies homolefus is, as, however, others beades. Dr Mayr think, identical with A. trachythyl/la. The leaf structure of the two is certainly different, and cultivation may yet reveal other differences. The names bicolor, Allockiania, apaments, pistonicis, pidomicis, microsperma, as applied to one rimore species of Picca, have been so vanously understood by botanists, owing partly to acceleratal insplacement of labels, admixture of seeds, and to imperfect information, that it is very important to have an authoritative statement from such an observer as Dr. Mayr If allowances be made for a large amount of variability within the conventional specific limitations, it

would seem from the figure as if Dr Mayr's Pinus pumila might be referred to P Cembra, whilst P. pentaphylla is obviously a near ally of the East American P strobus

Dr. Mayr's "diagnose," however, is really a rather description in German, not conveniently adapted for the comparison of one form with another. In this absence of concise comparisons in Latin, modern bodiantist, especially German ones, compare unfavourably with their prefecessors. On the other hand, Dr Mayr establishes some sectional characters which may prove useful, such as the three sections into which he divides the genus Pirea, w. Monthad, Caseita, and Omorica, the last, indeed, having been already proposed by Wilkomm

Hybrid forms between Praus Thusbergs and P denufors are mentioned, as well as a whole series of garden varieties which have either originated in Japanese gardens or have occurred as "sports" on the wild trees, and which have been propagated by grafting by the Japanese gardeners. These are likely to prove of scientific interest, and will be shecally interesting for garden purposes

Seven quarto coloured lithographic plates accompany the volume, giving details of the foliage and cones. We could have wished that representations of the trees themselves could have been upplied, and that an alphabetical index of species and varieties had been added to the classified table of contents. When we have so much that is valuable and interesting presented to us, it may seem ungracious to hint at deficiencies, but really in this acea to ask for more shows how greatly we appreciate what we have, and is about the greatest compliment we can pay to the author.

ELEMENTARY HYDROSTATICS

Solutions of Evamples in Elementary Hydrostatics By W. H. Besant, Sc. D., F.R. S., Fellow of St. John's College, Cambridge (Cambridge, Deighton, Bell, and Co., 1891)

THIS is a collection of solutions, or a crib, to the author's well-known "Elementary Hydrostatics," which has held the ground in elementary instruction unchallenged since 1803

It was cruel, though, as Dr Besant apologetically explains, unavoidable, to keep the world of instructors waiting so long for these much-needed solutions and explanations of the questions in his Hydrostatics

The Solutions are stated to be almost entirely drawn up by Mr A W Flux, who has found it necessary to explain that the equation $\hat{p} = p_0 \pi$ must be interpreted as giving the pressure \hat{p} in pointials per square food for in C.G.S. boson's, mught well have been added); but he has not explained that the effect of this reverential interpretation is to make p and w signify the same thing, so that two symbols are used to denote the same quantity, although one, p, is called the denity, and the other, w, the further weight.

But in 1863 the word poundal was not known, nor was any mode of measuring force and pressure in use, except in terms of gravitation units,

It would take too long to recount the despair of the instructor and the confusion of the stulent at the different

modes of reconciliation of the equations p = xpx and p = xpx, variously used as measuring the pressure at a death of x feet

Because thirty and more years ago it was thought convenient in dynamical equations to replace W/c by a single letter M, merely for purposes of convenience in writing and printing, it was and is still taught in our theoretical treatises that the equation $W = M_c$ is the expression of a subtle and fundamental law of Nature, to be introduced even into a treatise on Elementary Hydrostatics, presumably taken up before a student has commenced Dynamics, and before he can understand what acceleration in general, and the particular acceleration R, can mean.

What mist, for instance, be the feeling of Tommy Aikins, when the Musketry Instructor begins on p i of the official "Treatise on Military Small Arms," 1888, with this definition of Mass, taken in a garbled form from chapter in of the Hydrostances and el-ewhere

"Mass The quantity of matter in any body, the sum of all the particles of the body; it is proportional to the weight, whatever be the figure, or whether the bulk or magnitude be great or small; for the weight is equal to the mass multiplied by the force of gravity, or W = MC, and the letters M and W are usually employed to denote the mass and awayfat respectively"

In short, this definition amounts to saying that mast is something we denote by the letter M, while warght is something we denote by the letter W, but we must always remember that W = Mc, where g is something unexplanted, even when we measure mass in pounds and weight also in pounds, so that if g appears in one place, it will cancel again somewhere else, and not affect the ultimate numerical result

But if, according to former instructions, we calculate the pressure from the equation $\beta=e_{PR}$, we must notice that β , the density as defined in chapter in , "Elementary Hydrostatics," is the weight in pounds of one-gift any of a cubic foot of the liquid, or β is the weight in pounds of one cubic foot of the liquid, so that g_P and w now measure the same quantity

The unfortunate instructor was formerly called upon to reconcile these opposing statements, that w is sometimes the same as ρ , and sometimes as $e\rho$, now, however, he can take refuge behind the definite statements of this authorized collection of solutions.

But what is most wanted is a mathematical Censorship, to go through our hydrostatical treatises, expunging all the r's.

As to the mere mathematical geometrical part of the solutions, this is doublets carried out with rine Cambridge elegance, of which Dr. Beant is so well known an exponent, a time however, in comparison with the difficulty of the interpretation of the units in some extraordinary questions relating to the equations W = gpV, questions at one time considered a valuable test of clear thinking on the part of the student.

We counsel everyone who values his peace of mind to procure a copy of these Solutions, if called upon to interpret and expound the numerical results of the original "Elementary Hydrostatics"

A G GREENHILL

OUR BOOK SHELF.

Plane Trigonometry for the Use of Colleges and Schools
With numerous Examples By I. Todhunter, F.R.S.
Revised by R. W. Hogg (London Macmillan and Co., 1801)

TODHUNIER's "Trigonometry" is a very familiar friend of ours, and we have now before us a bundle of letters which we received from the author in 1861 and 1862, in reply to our criticisms and corrections of the early editions The first edition swarmed with small errata, for the pointing out of which we received warm thanks was a good book for some years, on account of the excellent collection of problems, but of late it sadly wanted bringing up to date Mr. Hogg has done his work well, but possibly he would have produced a better independent book The first 200 pages have undergone very little change, and we have only noted here and there an interpolated article Chapter avin, "Miscellaneous Propositions," contains several novelties (as contrasted with the last edition we have of the original work), such as geometrical proofs of familiar formula and graphs of the trigonometrical functions There are numerous important additions in chapters xxi -xxiv, which bring this part of the work more en rapport with present day requirements, notably Schlomilch's resolution of $\sin \theta$ into factors, and a too brief account of hyperbolic functions. The prime feature is the addition of a very great number of excellent recent exercises in all parts of the subject. The work forms a good school-book, and will meet the requirements of a large number of students.

Lessons in Astronomy By C A. Young, Ph.D. LL.D. (Bosson, U.S.A., and London Ginn and Co.1, 807). THIS is the third of a series of text-books recently prepared by Prof. Young for use in schools and colleges of different grades. The two previous ones have already been noticed in Nat LORE (vol vxxx) p. 595, and vol in p. 483). The present work is described on the tutle page as "a schools and serimantes". The three books have much in common, and each one has many good points. We cannot help feeling, however, that the steps between them are too small. Almost exactly the same ground is covered by acid, and they differ chiefly in the amount of mathematics required for a thorough comprehension of the "General Astronomy" so po means great, and even for the "Lessons" a certain knowledge of geometrical principles is essential I we must needs have three books, the "General Astronomy" contains too little, and much. Some "a book of some 550 pages—contains too much.

The chef variation calling for notice is in the portion chaining with uranography. This now forms chapter in, and, with the aid of the maps, forms a fairly complete and easy guide to the constellations. The notes on the legendary mythology of the constellations, which have been added for the benefit of students not acquainted with classical literature, gives this chapter an additional

The book is brought well up to date, and is a model of good printing

Cosmical Evolution · a New Theory of the Mechanism of Nature By Evan McLennan. (Chicago Donohue, Henneberry, and Co., 1800)

THE author states that the essential principle of the new theory is "that every known heavenly body is connected with its neighbouring heavenly bodies by means of real, material bonds, and that every phenomenon of the universe, without exception, is due solely to the action of bodies upon one another through, and by means of, these bonds which join them together" (p. 48)

NO. 1137, VOL. 44]

Among the principal evidences in favour of the existence of this material planetary connection is that "we actually see them with the naked eye" in the zodiacal light and in the streamers of the solar corona

The theory is of a very general nature, and includes not only cosmical but terrestrial phenomena, such as aerial and aqueous tides, terrestrial electricity and magnetism. The author is of opinion that "the greater tidal wave is due to the sun, and the lesser to the moon" (p. 291)

The conditions of prelunar and other races of mankind are also discussed (p 360) The work consists of 399 pages There is no index

The Telescope an Introduction to the Study of the Heavens By J W Williams. (London Swan Sonnenschein and Co., 1891)

THE writer of this book is author of "British Fossils, and where to Seek Them," and "Land and Water Shells, &c." In his preface he quotes with approval the adage, "Ground your knowledge of any special group on a general knowledge of mature as a whole." This is pullups why he now turns his attention from shells carefully compiled, and is to be recommended as a safe guide. Some of the illustrations are excellent.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Nither can he undertake to return, or to correspond with the worters of, rejected manuscripts intended for this or any other part of NATURE. No notices is taken of anonymous communications!

Silver Lodes and Salt Lakes

Shake the discovery, some five or us, years ago, of the extraontinuary links, in full lode of suber hearing ores, the public asentended with consumartuely little securities interest in regard to the geological features of the argentiferous country added to probable, origin of depoints so well and or reinstrabled in the probable, origin of depoints as over and or reinstrabled in the graphical and geological Features of the eastern pairs of South Astusials and the western parts of New South Wales will probably throw more light upon the interesting subject of the onigin of argentifeross lodes; than the study of usy other now known part of the globe, and, as I have had an opportunity of going do depended to the matter during a recent visit to Broken ground the state of the state of the control of the subject of the proportion of the subject of the which seem to afford presumptive evidence in favour of the supportion that sail takes and silve todes are exastly connected.

postton that sait lakes and slives lodes are causally connected.

An examination of the ores in this at Bloten Hill, and especially in the portions of the lode which are known as blocks to and it, reveals the fact that stantification almost exactly versal throughout the lode. So obvious has this been from the very beginning of the working, that almost every mining man who has had anything to do with Broken Hill has remarked upon the very obvious fact that the ores are to be ascribed to an aspectos when the said of th

ore took place, it is evident that the conditions at the time ore took place, it is evident that the conditions at the time must have been very different from what they are at present. The key to the whole situation teems to lie in the fact, which has been so well pointed out by Mr. Alfred Russel Wallace and others, that the whole of the regions of Central Australia and others, that the whole of the regions of Central Australia have emerged from the ocean at a period which, from a geo logical point of view, is comparatively recent. The axial lines of the watershed ranges appear to be rising at a more rapid rate than the neighbouring plains, and consequently some strange. and interesting changes are taking place in the relations of the eatchment areas of flood waters and their outlets. In the locality of Innamincka, almost due north from Broken Hill, there occurs a phenomenon which is obviously due to some such change of relations. The Strezlecki Creek runs to the south west from Innamincka. Its bed holds immense deposits of drift sand, and in the adjoining plains are to be seen many curious parallel ridges of sand-hills, all strongly suggestive of the action of drift ridges of sand-fulls, all strongly suggestive of the action of our water, such as at times passes across the surface of these vast interior plains at flood time. The Stretlecki Creek was apparently the outlet for most if not all of the water of Cooper's Creek at some period of time not at all remote. But at the Creek at some period in time not at all remove but at the present day it is only once in every four or five years, that the stream runs at all. When a very high flood fills the bed of the Cooper to overflowing, the waters find their way over the low ridge of land which separates the present bed of the Cooper from that of the Stretzlecki, and so on to Lake, Blanche and Gregory-those large salt evaporation pans which can scarcely Gregory—those large sait evaporation pains when con season, with propriety be dignified with the name of lakes. The gradual elevation of the low ridge would appear to be the most probable avalanation of this interesting phenomenon. Now, to the south of Broken Hill, and in the vicinity of the River Darling, there is to be found ample cyclence of a somewhat similar occurrence Vast accumulations of sand in parallel radges are still to be seen vast accumulations of sand in parallel ridges are still to be seen crossing the plains, and a large river bed extends, from a pluce quite close to the junction of the Darling and Murray, nonthwards in the direction of Broken 11bl. Whether this "Anabinach," as it is called, is really an old bed of the River Darling or not, I will not stay to imquire. It would, however, appear practically certain that some slight alteration in the level of the land has been responsible for the change in the direction of the flow of

The case is not an ordinary one of the diversion of a river owing to the accumulation of its own allwiums, and this and ordiges, which is place extend right down to the bad of the sand redges, which is place extend right down to the bad of the ward of the country of the control of the country of the control of the country of the present of the product of the country of the present of the product of the present country of the present of the product of the present of t

But this has not been the case in times gone by. The evidences of the action of water in the neighbourhood of the "Anabranch" makes it to appear practically celtain that at one time the flood waters, which is well through the sail takes, must found an outlet by that meant. This, then, briggs me to the most significant fact to which I wish to direct attention. The locality of Broken Hill is the lowest point in the axis of the line of country which forms what I have alluded to as the wild et al. In the absence of any survey from which fall data could be alluded, it is infriend to have the levels of all the ratlway deduced, it is infriend to have the levels of all the ratlway two miles north east of Broken Hill. These show that the ratlway which happens to follow the line of the ratley days gradually to Broken Hill, and then rises again towards Tarrisangle. The conclusions a therefore neutrals from the data

to which I have already referred, that Broken Hill is the locality at which the accumulations of flood water from the great region of the sait indees must have found their way across the connection of the sait indees must have found their way across the connection of the sait indees must have found their way across the connection of the sait indees must have found to the connection of the sait indees and the sait of the sait indees and the sa

A Magnificent Meteor

AF 115 a m, on July 31, I observed a most magnificest meteor—a versible Andomodes! It was much larger than Jupiter, which was on my right, in the constellation Pares, returned to yellow the properties of the properties of the properties of the properties of the yellow being opportunely blench, but it oboded at least to be called a fire-hall. It alluminated the whole district with the building of the properties of the prope

bright, but of short duration.

On the night of July 31, and on the morning of August 1, there was a brillium display of stars for this time of the year, the Milly Way was well defined from horzon to houson, denoting a cerum degree of front. At present, Jupite to the production of the present of the present, Jupite of the present of t

Paisley, August 3

Bees and Honey-dew.

Nash here is an avenue of alternate beech and oak tuees, and, in walking through it, my attention has lately been drawn to a loud humming in the beeches, smilar to that heard in lime trees when in flower, while the oaks are widen. The sound is, if find, produced from here in search of the Aphis secretains on the leaves of the beeches, the under valed of which her witch. With the substance. The been appeared in the contract of the contract of the contract of the contract of the leaves affect, but past on the manging, and the under valed of the leaves affect, but past on the manging,

and then creep underneath, when, after running about and exhausting the supply, they fly off to another leaf, exactly as if they were visiting flowers. The leaves of the oaks are elean, and have no "honey-dew" on them F. M Burron. Highfield, Gainsborough, August 5

Dredging Products

Amongst the products of the dredgings which my friend the Rev. J. H. Crawford and I are procuring from the Voe here, I am glad to be able to record the presence of Actinotrocha. We only got two or three specimens at first, but to day a large only got two or three specimens at first, but to day a large number was procured from the surface net. One or two have attained to the Phoronis condition since being brought in. They answer in all respects to Actinotrocha branchiata, but seem to be as a rule less pigmented than the specimen found in St.

Activotrocha branchiata has no w been found on both sides of Activate cela is nucleated has now been found on both sides of Socialand and England, and also at Helippiand, but, bested being got in the North Sea and on the west coast of Britan (etd. NATURE, vol XXXV). It seems also to be found on the western aide of the Atlantic, for Wilson records it from Cheapacke Bay It is thus distinctly a northern form, but has a wider distribution than has hitherto been supposed.

ALUK MEKK.

Sullom, Northmavine, Sheiland, August 4

THE INTERNATIONAL CONGRESS OF HYGIENE AND DEMOGRAPHY

N EVER before, perhaps, in the history of science has there been assembled together such a numerous gathering of eminent inen of science of different nationalities, or representing so many countries, for the purpose of discussing scientific problems

Although it is little to the national credit that the imporance of international Conferences on Health was suggested by the Belgians and not by ourselves, the conditions we are under here must not be forgotten. All other civilized countries have strongly represented among their Ministers, and among administrators, men of knowledge and competence, and elsewhere such Congresses are treated as of national concern

Here, even in the matter of health, such powerful and economical methods of obtaining and distributing know-ledge, such as Congresses like the present afford, are absolutely ignored by the party politicians to whom we

commit our national welfare

There can be little doubt that most of the good which is certain to alise from the deliberations now going on must be ascribed to the Queen and Prince of Wales, who must be ascribed to the Queen and Prince of Wales, who came forward as Patron and President of a Congress ignored, as we have said, by our party rulers This has been pointed out by the St James's Gazette—"The Prince of Wales has rendered a not inconsiderable service to his country by good naturedly pulling the Con-gress out of the fire, and rendering a partial success of gress out or the fire, and rendering a partial success of what came near to being a sad faux. But for his complaisance in sacrificing his holiday in coming up to London to take the chair, no public personage would have been present to welcome the two or three thousand. guests bidden to the metropolis, or to give attraction and dignity to the opening meeting There are three Ministers whose departments have relation to the sub-jects treated by the Congress. Mr. Ritchie, who is our quan Minister of public health and relief, Mr. Chaplin, whose department deals with the hygiene and prevention of disease of animals; and Lord Cranbrook, who controls medical education Not one of these Ministers was present yesterday. Not even the Registrar-General, the tive of the Home Secretary, took part in yesterday's "meening The Prince, however, saved the position '

The devoted and enpaid labours of many eminent men have, however, with this slight touch of rational feeling

in high quarters, already rendered the success of the Congress unparalleled, and it is really wonderful to see Congress unparalleled, and it is reany wonderful to see what they have done, in spite of the enormous difficulty of arranging for a large number of people in such a city as London. Even the facilities afforded by Burlington House and the University of London buildings do not include a hall large enough for an adequate reception room; at first, therefore, there were difficulties, largely owing to its absence. This will hardly be wondered at, when we state that the numbers enrolled already are about 3000, and that there are 40 delegates from the German Empire and 70 from India, only to give two instances.

In anticipation of the meeting, among other official documents too numerous to mention, was prepared a Hand-book to London, with special reference to the needs of the members This is a volume of 250 pages, in French and English, with eight plates showing the position of hospitals, cemeteries, markets, and the like I his has been published by Messrs Cassell There is another volume of 233 pages, containing abstracts of the more important papers pages, containing abstacts of the more important papers to be read. Nor have the English Committee been the only workers. We have "Denmark its Medical Organization, Hygiene, and Demography," with numerous illustrations and maps, published in English by authority. of the Danish Government in time for the International Congress This has been published by Messrs Chuichill

In spite of the abstentation of any notice on behalf of the Government, it is pleasant to note the way in which the Lord Mayor and the Corporation, the Royal Colleges of Physicians and Surgeons, and numerous other public bodies and private individuals have kept up the credit of the nation for hospitality Among the conver-sations must be specially mentioned that at the Guildhall on Tucsday evening, when the Loid Mayor received the members of the Congress It was a brilliant and impressive sight, enhanced by the uniforms of foreign officers, and the unfamiliar garbs of members of our own distant dependencies The various social arrangements made by the organizing committee are recorded in a special pamphlet of fourteen pages

The proceedings began on Monday by a meeting in St. ames's Hall, presided over by the Prince of Wales Douglas Galton first presented the Report of the Permanent International Committee, and inter alsa gave the

following account of the general organization -

"The work of the Congress has been arranged in two divisions, viz hygiene and demography, and it has been found necessary to divide the former into nine sections, each under a separate president, and with separate organization Committees have been organized in foreign countries to further the interests of the Congress in a more direct manner than could be done from England Delegates have been appointed by all the Governments of Europe, and also by the United States, Mexico, Venezuela, Japan, Persia, Egypt, by the provinces and native states of the Empire of India, by the most important colonies, and also by numerous municipal authorities, universities, scientific and medical societies, and other institutions throughout the world, and large numbers of the most important authorities on the subjects to be treated of have sent communications to be laid before the Congress."

After the reading of this Report, the Prince of Wales

opened the proceedings by a careful and sympathetic address. One part of it referred to the dangers to health inevitable to the conditions under which we live. He remarked in relation to these dangers.—

"It will be no trivial work if their sources and probable remedies can be clearly pointed out, and especially if this can be done, as in a Congress such as this it should be, in a strictly scientific manner, calmly and dispassionately, without any reference to either general or municipal politics, or for any other purpose than the promotion of health It is only on conviction such as may thus be produced that the appointed sanitary authorities can compel the changes necessary to be made; for such changes are almost always inconvenient or injurious to some, and might even seem unjust to them, unless it be made quite clear that they would be very beneficial to the community But my hope is that the work of this Congress may not be limited to the influence which it may exercise on sanitary authorities It will have a still better influence if it will teach all people in all classes of society how much everyone may do for the improvement of the sanitary conditions among which he has to live I say distinctly all classes, for although the heaviest penalties of insanitary arrangements fall on the poor, who are themselves least able to prevent or bear them, yet no class is free from their dangers or sufficiently careful to avert them Where could one find a family which has not in some of its members suffered from typhoid fever or diphtheria, or others of those illnesses which are especially called 'preventable diseases'? Where is there a family in which it might not be asked, 'If preventable, why not prevented?' I would add that the questions before the Congress, and in which all should take a personal interest. do not relate only to the prevention of death or of serious diseases, but to the maintenance of the conditions in which the greatest working power may be sustained

The Times, in a leading article on the Prince's address, points out one very important practical matter in which we lag far behind many foreign countries, and which may serve as an excellent illustration of the Prince's words about inconvenience or apparent injustice to individuals "The weak point of English sanitary law is in respect of regulations for the slaughter of animals" In London, for example, slaughterhouses are small private establishments, often situate up little alleys or courts, surrounded by dwelling-houses, and not only destitute of many conveniences which they should possess, but also affording great facilities for the slaughter of diseased animals, and for the distribution of their flesh as food. In many Continental cities public abattors have been established upon a large scale, and all private slaughtering is forbidden At these abattorrs there is an abundance of space, of air, of light, there is an excellent water supply, and the slaughtering is conducted under the supervision of officials, governed by rules which not only protect cattle against unnecessary cruelty or ill-usage but which provide for the systematic inspection of meat before it is permitted to be sold. We shall certainly hear a good deal, during the sitting of the Congress, as to the importance of preventing the consumption of the flesh of tuberculous animals; but this, however important it may be, can never be done while the innumerable small private slaughterhouses are suffered to remain.'

At the conclusion of the Prince's address, speeches were delivered by representatives of France, Italy, Austria-Hungary, Saxony, and Prussia It is pleasing to record that all bore high tribute to the part which has been played by England in the promotion of measures calculated to preserve and improve the public health. On this point, Dr. Brouardel (France) was indeed specially emphatic -

"In the year 1837, the year of the coronation of Her Gracious Majesty, appeared the Act which rendered obligatory the registration of deaths Act maugurated the era of administrative reforms concerning the public health which our valued colleague of the Local Government Board has rightly called 'the Victorian era' This Act did not long remain alone. Under the impulse given by two of your most illustrious patriots, William Farr and Edwin Chadwick, you have organized a system of registration of the causes of diseases and of deaths Certain important cities, before the law made it obligatory, obtained supplies of water beyond all suspicion of pollution, and adopted systems

cities, whose action cannot be too much praised, the sickness and death rates diminished rapidly, this furnished the necessary proof it was time for reform Twenty vears ago the Local Government Board was established. years ago the Local Government noard was emousined, and in 1875 had submitted to Parliament a Bill for the protection of the public health During its discussion in Parliament none of your greatest Ministers (Disraeli) pronounced in the House of Commons these memorable words, which should be repeated in all countries and in all Parliaments 'The public health is the foundation on which repose the happiness of the people and the power of a country The care of the public health is the first duty of a statesman' Since this, each year you have made fresh improvements in your sanitary laws, if in your eyes they are not perfect, in the eyes of the nations who surround you they are an ideal towards which all their most ardent aspirations tend It is you example they invoke when they claim from the public authorities the powers necessary to oppose epidemics, to combat the scourges which decumate their populations. You have taken the first health: this is not all that you have done in the domain of hygiene Among the diseases which one can properly term pestilential, there are, thanks to the work of the hygienists of all countries, certain ones which from the present time may be considered as preventable such are small pox, typhoid fever, dysentery, and cholera For one of these, the most terrible, the immunity conferred by vaccination is absolute. The person upon whom this immunity is conferred can pass through the most severe cpidemics, and expose himself to all sources of contagion without being affected. Who is it who thus preserves from death, from blindness, from infirmity, millions of human beings of all countries and of all races? On May 18, 1796, a date which might well be the date of a great battle, Jenner moculated with vaccine matter by means of two superficial incisions, the youth James Phipps Protection against small pox belongs to you, the world will be to you for ever obliged let us consider two other epidemic diseases. Is it possible to establish the conditions of propagation of typhoid fever without quoting the names of Budd or of Murchison ! I am aware that in 1855 Dr. Michel de Chaumont had for the town in which he lived experimentally established the rôle played by drinking-water in the propagation of this disease. Unhappily, public opinion was not prepared, and his discovery was not listened to In the work which we are considering, the efforts of the English school were most fruitful May I recall the fact that it was the epidemic of cholera in 1866 in England, which gave birth to the theory of its propagation by drinking-water? Was it not at that date that, under the influence of your hygienists, the Lords of the Privy Council issued an order formulating the laws of prevention which we adopt to-day? Certain it is that even in England these discoveries liave not immediately borne all their fruit. The anti-vaccination leagues are not yet dead Proofs accumulated during a century have not sufficed to cure that mental blindness which is congenial . Can France be represented in a Congress of Hygiene without recalling the name of M Pasteur? For centuries we have asserted that epidenne diseases were propagated by means of contact, by the air, by the effluvia, by miasmata The idea of morbific germs, if not the name, is even found in the works of Hippocrates, but in what an uncertain sense The theory of contagion has passed from century to century with strange modifications; the uncertainty of the methods of research and the difficulties of observation bound up together truth and error It remained for Pasteur to prove the existence of these germs, their form, their life, their mode of action, and by their attenuation to solve the problem of immunity Thanks to his work, and beyond all suspicion of pollution, and adopted systems thanks to those of his pupils, icalities have succeeded to of removal of foul water and waste matters. In these contingent possibilities. We know some of our enemies. their habits, and their mode of penetrating the body; u po this time main was conquered by these infinitesimal beings, but, thanks to recent discoveries, he will be their conqueror When, at the beginning of a century, one can inscribe the race may reque: More hab been done for it against misery, deases, and death than in any one of the centuries which have preceded it. You, gentlemen, you have been the mitators, this rule will never be dispated with you by the preceding the property of the

Dr. Van Coler, the Medical Director-General of the Prussian Army, the representative of the German Government, followed suit, and showed the aid tendered to armies by the improvements in sanitary science. We give the following short extracts from his speech.— "It is indeed with a feeling of joyous pride that from this

place and in this country, where we have to trace the very cradle of all modern science of public health, I am permitted to point out how the many efforts made in the direction of hygiene radiating from I ngland were, especially in Germany, hailed with much delight, where they received the most careful attention, and where they ever since have been most actively promoted . If from our army, diseases like malaria, small-pox, dysentery, have completely, or almost completely, disappeared. If typhus fever and diphtheria become more and more diseases of the past, we have to be thankful for these attainments to the development and application of hygiene It is now an established fact that infectious diseases are by no means a necessary evil in the army I hey are simply diseases which can be avoided, which can be powerfully opposed, and against which the science of our days battles vic-toriously with ever-increasing success."

Dr Korosi's address will be welcome to many, as he exactly defined demography—which is a puzzle to many outsiders—and pointed out the early work done by mem-

bers of the Royal Sucrety -

This branch of science, the very nucleus of statistical work, which, in fact, is quite a science in its own right, has chosen the task to investigate the laws which regulate the life, increase, and decrease of nations. Its work, therefore, comprises three main parts statistics of natality, of mortality (his patt including biometry, the science of measuring the duration of human life), and of the increase of population. And when inquiring now who were the founders of this new science, we shall hear unanimously quoted the names of England's sons-Graunt, Petty, Halley, Malthus Gentlemen, to-morrow, when we are to begin our work, we shall meet within the venerable hall of the Royal Society The representatives of demography must feel a deep emotion when entering those rooms, which are so intimately connected with the history of their science, for this is the place where, 220 years ago, demography was created. It was in those halls, in their very first youth then, but soon conspicuous to the whole world by the genus of Newton, that appeared the work of Graunt which forms the startingpoint of demography, and here the King himself, admirably appreciating the work done, recommended the author to be received as a member of the learned Society It was there that shortly afterwards Sir William Petty, by his eminent power, raised the new science to political importance and to popularity, and in the same place, again, in 1693, the famous Halley became the founder of the most important part of demography, of

halls shy and even without a name, has found its way over the whole globe. Having been worked out in Germany, having received a name and new ideas in France, and having been enlarged and imbued with a more scientific character by Quetelet, having got its well-equip ed office in every country of the civilized world, we are groud to see now its numerous representatives meet at the same place where two centuries ago this science was born. After a triumphant career of 220 years, it returns to its home, to the old rooms in which it awoke to light, and again the Throne of England receives it with favour and benevolent interest For demography not less than for all statistical work, it is of the highest importance that its representa-tives, scattered as they are over the whole globe, should fully understand each other, for only so we can accomplish our aim, that our observations comprise equally all countries of the world, that our researches are conducted and worked out on the same principles everywhere, and that we may unite the incomplete and often discrepant descriptions of the single nations to a full descriptive history of the whole of civilized mankind This great aim fully deserves the praise the illustrious Prince Consort bestowed upon it from this very place thirty years ago He said, 'The importance of the Congresses cannot be over-rated, they not only awaken public attention to the value of these pursuits, bring together men of all countries who devote their lives to them, and who are thus enabled to exchange their thoughts and varied experiences, but they pave the way to an agreement among different Covernments and nations to follow up these common inquiries in a common spirit by a common method and for a common end?"

The meeting was subsequently addressed by Sir James Paget, Dr. G. Buchanan (of the Local Government Board), and others

The Sectional work of the Congress began on Tuesday. The Divisions and Sections are as follow. —

any most Disbastion of President, and the president, but Joseph Fayrer, K C SI — Section 2 Batteriology President, shr Joseph Baster, Bart — Section 3 Batteriology President, shr Joseph Baster, Bart — Section 4 Infancy, Childhood, and School Life—Section 5 Infancy, Childhood, and School Life—President, shr Henry Roscoe, M P — Section 6 Architecture in Relation to Hygene President, 5r Arthur W Biomfield, A R A — Section 7 Linguisering in Relation Section 8 Children President, John State Batterion Company and District President, Section 8 Children Section 8 Ch

Division 11 - Demography President, Mr Francis

We shall endeavour next week to give an idea of the sessits of the many important discussions which may be anticipated, but it is already clear that it will be impossible for us to give anything like a full report, for the programme of work to be gone through is enormous The addresses of the various presidents on the opening day were in themselves important communications, and well fitted to give tone to the subsequent discussions.

PROGRAMME OF TECHNOLOGICAL EXAMINATIONS.

A SIGN of the general advance in technical education author to be received as a member of the learned Society. It was there that shortly afterwards Six Wilham Petty, by his eminent power, raised the new science to political importance and to popularity, and in the same place, again, in 1693, the famous Halley became the clouder of the most important part of demography, of biometry, by working out the first table of mortality. And the conditions of the more important trades as practised one whe young science, which two centures ago left those

of the sixty subjects are divided into different sections. corresponding to the separate branches of the same trade, or to the practice of the trade in separate localities.

In the new Programme we notice many important additions A practical test, which is the surest preventive of cram, and excludes those who are not engaged in the trade from presenting themselves for examination, has been added to the syllabus of nearly all the subjects. Thus, next year, for the first time, there will be practical examinations in such widely different subjects as photography and boot and shoe manufacture In many subjects dealing largely with the practical applications of science the syllabus has been entirely re-written. This is the case with "Electrical Lingmeering," which is now divided into two main subjects—"Telegraphy" and "The Transmission of Power"—the former being again subdivided, in the honours grade, into " Felegraphy" and "Telephony," and the latter into "Flectical Instru-ments," "Electric Lighting" and "Dynamos, Motors, ments," "Electric Lighting" and "Dynamos, "See". The subject of "Mechanical Engineering" is simihas been increased by the addition of a syllabus of instruction in " Goldsmiths' Work," in which subject a large class has been already established in Birmingham, and of a syllabus in "Ship Carpentry and Joinery, intended to meet the requirements of artisans engage 1 in the different shipbuilding yards throughout the country

The continuous increase in the number of candidates for these examinations, and in the number of students receiving instruction in the different centies throughout the country, shows that there is a genuine demand among artisans for practical and concrete instruction dealing, in the first place, with the facts with which they are familiar in their every-day work, and, afterwards, with the scientific principles explanatory of those facts. From the table found on p 17 of the Programme, it appears that this found on p 17 of the Programme, it appears that this year 7322 candidates presented themselves, as against 6667 in the previous year, and that the number of students under instruction increased from 12,022 to

13,202
The memorandum issued to County Councils, to which we have already referred in these columns, is ie published in the Programme It draws the attention of County and Borough Councils to the fact that, after the examination in May 1892, the grants hitherto paid on the results of the examination will be withdrawn, and that a sub stantial portion of the funds thus set free will be devoted to the improvement of the machinery of the Indications of the direction in which examinations these improvements will be made will be found in the new Programme It is important that the managers of technical classes should fully understand that, in future, the maintenance of such classes will depend entirely on local support The large sums placed at the disposal of County Councils clearly render it no longer necessary that the City (suilds Institute should continue to make grants on results, which, although amounting in the aggregate to a large sum of money, proved to be quite inadequate to properly support the classes. It is, however, to be feared that the grant-earning tendency of the teachers and managers of local schools may cause the distinctly technological subjects of instruction to be neglected for the sake of science subjects by which grants may still be obtained from South Kensington To prevent this, it is necessary that County Councils should realize the full importance of the work which Parliament has thrown upon them, and should recognize that in future they will be the authorities responsible for the conduct of the technical and, indeed, the secondary education also of the county. In the competition for money grants, technical subjects will be placed at a distinct disadvantage as compared with ordinary science subjects, and it is the more necessary, therefore, that the teaching of these

subjects should receive adequate support from local authorities

In order that the teaching in different localities may be duly adapted to the trades practised in those localities, and may be regulated by these requirements, and not by the grant-earning capacity of the subjects of instruction, it is very desirable that County Councils should organize. independently, or in connection with the City Guilds Institute, a system of inspection of local classes value of examinations is immeasurably increased when they are supplemented by inspection by competent experts, and it is to be hoped that some system of inspection of technical schools, which shall include the methods of instruction adopted, will soon be organized.

The Institute's Programme offers to different localities.

a wide choice of trade subjects, ranging from simple handicrafts to industries involving some of the most difficult applications of physical and chemical science To the syllabus of each subject is added a valuable list of works of reference, which forms by itself a very complete guide to books in technology. The list of examiners. many of whom have this year been newly appointed, includes well-known experts in each branch of trade, and is a guarantee of the efficiency of the examinations.

The future development of technical education is now very largely under the control of County Councils They possess the funds without which no real progress can be But, besides funds, experience and organization are needed, and there can be no doubt that the members of County and Borough Councils will derive much valu able information, and many serviceable suggestions, from the new edition of the City Guilds Institute's Programme of Technological Examinations

BOTANICAL SURVILY OF INDIA

THE organization of a Botanical Survey of India. which has been under consideration since 1885, has been finally settled by the following resolution of the Covernment of India, dated Calcutta, February 26, 1801 -

(1) The scheme for carrying out the botanical survey of India, which has been under consideration for some time, was finally completed a year ago, and His Excellency the Governor-General in Council considers that it is now desirable to publish the details for the general information of local Governments and Administrations

(2) In February 1885, Mr Thiselton Dyer, Director of the Royal Cardens at Kew, prepared for the Government of Madras a Memorandum on the constitution of a Botanical Department for the Madras Presidency, one result of which was the eventual establishment of a Botanical Department for that Presidency In sanctioning the Madras Department, the Secretary of State for India took the opportunity to suggest for the consideration of the Government of India whether, without interfering with the control exercised by the Provincial Governments, it would not be possible to bring into communication the various Botanical Departments of the different Provinces, the desirability of such an association having been promiently noticed by Mr Thiselton Dyer in his Memorandum of February 1885 The wider in his Memorandiim of February 1885. The wider scheme thus suggested by the Secretary of State was accordingly considered; and the first step taken for the organization of a Botanical Survey for all India, which was to have its centre in the Royal Botanical Gardens at Seebpur, Calcutta, was the transfer from the control of the Government of the North Western Provinces and Oudh, to that of the Government of India, of the Superintendent of the Botanical Gardens at Saharanpur measure was demanded by the need for botanical survey in the Punjab, Rajputana, Central India, and the Central Provinces, which had hitherto been unrepresented by any

botanical officer, as well as by the necessity for having a botanical officer at the disposal of the Government of India to accompany military expeditions beyond the frontier Arrangements were then made, with the concurrence of the local Governments concerned, under which the follow-

ing territorial division of India was prescribed for the

purposes of botanical survey — Under the Superintendent, Royal Botanical Gardens, Calcutta - The Provinces of Benyal, Assam, and Burma, the Andamans and Nicobars, North-East Frontier Expe-

Under the Government Botanist, Madras -The Presidency of Madras, the State of Hyderabad, the State of Mysore

Under the Principal, College of Science, Poona - The

Presidency of Bombay, including Sind
Under the Director, Bolanical Department, Northern
India—The North-Western Provinces and Oudh, the

Punjab, the Central Provinces, Central India, Rajputana, North-West Frontier Expeditions The distribution above stated was reported to Her Majesty's Secretary of State, and his Lordship has been

pleased to express his satisfaction with these arrangemente

(3) The Government of India now desire to communicate the following observations as to the central position which, in conformity with the suggestions of the Director of the Royal Botanical Gardens at Kew, the officer at Seebpur will occupy in the scheme for the botanical survey of India, and as to the sphere and nature of duties of each botanical officer, so far as they are connected with botanical survey

It is desirable that the Seebpur Institution-which, as remarked by Mr Thiselton Dyer, "though technically Provincial, must, at any rate in external estimation, from its age (it has passed its centenary), from its scientific traditions, and from the splendour of its maintenance, rank as Imperial "—should, without any interference with the Provincial control over the Royal Botanical Gardens, be officially recognized as the acknowledged centre of the Botanical Survey of India, and that to it should be referred the solution of all problems rising out of the practical or scientific study of Indian botany. In view of the important position which the Superintendent of the Royal Botanical Gaidens, Calcutta, will thus occupy as the central authority in the Botanical Survey of India, the Government of India have, with the concurrence of the Secretary of State, added to Dr King's present designation the official title of "Director of the Botanical Survey of India," and it is requested that in all correspondence dealing with subjects relating to general botanical exploration the latter title should be employed. The more effective botanical survey of Birma and Assam has also been intrusted to the Director, who will arrange a definite programme each year for the purpose in com-munication with the Chief Commissioners of those Pro-He will also submit a separate Annual Report on the botanical exploration and researches effected during the year. The Government of India record with satisfaction that the local Administrations of Burma and Assam have each contributed an annual grant from Provincial revenues as an addition to the Imperial grant for the botanical survey of their provinces.

The investigation of the flora of the Madras Presidency and of the Hyderabad and Mysore States has been in-trusted to Mr. M. A. Lawson, the Government Botanist and Director of Cinchona Plantations, who has expressed his opinion that the whole survey of the territories in question might, if diligently prosecuted, be completed in three or four years

In Bombay, a scheme involving an annual expenditure of Rs. 4500 per annum on botanical work has been sanctioned and Dr Cooke, Principal of the College of Science, Pouta, is officially recognized as in charge of

botanical research in that Presidency. A herbarium exists at the College of Science, and a botanical collec-tion is in course of formation at the Victoria Gardens, Bombay The former place is to be the head-quarters of botanical research and collections, and the existing herbarium there is to be developed

By the transfer of the services of the Superintendent of the Government Botanical Gardens, Saharannur-who now bears the designation of Director of the Botanical Department, Northern India-the services of this officer are, as already explained, available for scientific investigation in all Provinces and States in Northern and Central India, as well as on expeditions beyond the north-west frontier Mr. Duthie, the officer now holding the appointment, was thus in 1888, by his deputation to accompany the Black Mountain Expedition, enabled to acquire in-formation concerning the flora of a country which had not hitherto been botanically explored. During the last three years, Mr Duthie has also been deputed to Simia in the hot weather to assist in the preparation of the "Dictionary of the Economic Products of India," and during the same period he has been engaged in the botanical exploration of Rajputana and of the Central Provinces.

M. FAYE'S THEORY OF CYCLONES

N his admirable work on "The Principles of Science." I the late Prof Jevons thus sums up the characteristic mental attributes of the great scientific discoverer .—

"He must be fertile in theories and hypotheses, and yet full of facts and precise results of experience. He must entertain the feeblest analogies and the merest guesses at truth, and yet he must hold them as worthless full they are verified in experiment. Where there are any grounds of probability, he must hold tenaciously to an old opinion, and yet he must be prepared at any moment to relinquish it when a single clearly contra dictory fact is encountered "

In his theory of cyclones, M Faye has abundantly proved himself to possess those attributes that are defined in the first phrase of each of these sentences, and particularly the final one Whether, however, in his treatment of this subject, the manifestation of the remaining and qualifying attributes is equally recognizable; whether he has fairly grasped and duly weighed all the established facts that are relevant and even essential to his hypothesis; and whether, among those that he has overlooked, there are not some that are "clearly contradictory' to the re-quirements of his theory, and therefore fatal to it—these are the questions that I propose to inquire into in the present article

A true theory of cyclonic storms has not merely a scientific interest, it has also practical bearings of very high importance When a ship is involved in the outer circle of a tropical cyclone, the vital problem which the seaman has to solve is, how to escape the fearful squalls of the inner vortex and the tremendous cross-seas of the central caim. In order to do this he must be able to judge of the bearing of the storm-centre from the actual position of his ship, and, to determine this point with even approximate accuracy, his sole guide is the direction of the wind It may well be, then, that the safety of his ship, his own life and those of his fellow-seamen, are involved in the right answering of this question, "Does the storm-centre bear at right angles to the local direction of the wind, or is it from two to four points in advance of this position?" M. Faye's theory assumes and inculcates the former; the latter is consistent only with the hypothesis of an indraught from all sides, and an ascending current over the storm, the existence of which M Faye persistently denies.

M Fave's views on the nature of cyclonic storms are

too well known to render necessary any detailed descriptoo well known to render necessary any detailed descrip-tion of them. An account given by Mr Archibald in vol. xxxviii. of this journal (p 149) is quoted without dis-approval by M Faye in his latest publication in the Complex rendus, and may therefore be accepted as just Its essential points are that cyclones are generated as great eddies in the higher regions of the atmosphere, and that there is a downrush of air in the vortex "Dans ces tourbillons, tout semblables à ceux qui se forment dans les cours d'eau, les spires, d'abord très larges, iront en se rétrécissant par en bas, et leur girations progressivement accélérées, en vertu d'une loi bien connue de mécanique, amenent au contact du sol, et y concen-trent sous une aire bien plus étroite que celle de leur embouchure les énergies continuellement renouvellées du fleuve aenen jusqu'à ce que son clargissement croissant aboutisse à la décomposition du cyclone "

Further on, with respect to the descending current in the vortex, he remarks "L'air envoyé en bis sera en petite quantité mais animé d'une vitesse de rotation

ćnorme.

I leave aside for the present any criticism of the physical and mechanical actions which M Fave conceives to take place in these unfortunately inaccessible vortices of the higher atmosphere, and which I, for one, am unable to reconcile either with the results of direct observation or with well-established physical laws. For the moment I wish to concentrate attention on the question of fact, whether there is an indraught of air to the cyclone vortex at the earth's surface, and therefore necessarily an ascending current over it, or, on the contrary, an outflow from a descending current This is the crucial point of from a descending current. This is the crucial point of the controversy, and by the answer M. Faye's theory must stand or fall. Indeed, M. Faye seems to recognize this, since he says -

"L'argument le plus solide, celui qu'on m'opposait toujours nour prouver que l'air était ascendant dans les cyclones, à savoir le fait que les isobares étaient partout et toujours coupés sous un angle assez notable par les flèches des vents, de manière à accuser une tendance

nettement centripète, &c "

He admits, too, that in certain cases there is really an indraught and ascent of air; only, on his view, these are not cyclones

In order to forestall any objection on this score, I will take as the subject of inquiry the cyclones of the Bay of Bengal, the typical cyclones to which Mr Piddington first applied the name, however etymologically incorrect I trust, by this restriction, to escape ignominious dismissal from court on the plea that my witnesses are impostors—merely "prétendus cyclones"—and that their evidence

is consequently irrelevant.

My first experience of a great tropical cyclone was the memorable storm that devastated the port and city of Calcutta on October 5, 1864 Up to that time, my acquaintance with cyclones was, like M Faye's, "academic"; and under the impression that Reid's and Piddington's description of the winds, as blowing in circles or at right angles to the radius vector of the vortex, was an established scientific fact, on the evening of that day I sketched out, for the information of some friends, the probable course of the storm that was then passing away, having swept the port of its shipping, and left half the nouses around us more or less wrecks. Having no other guide at the moment than the changing directions of the hurricane as experienced at Calcutta, on the supposition that the centre lay at right angles to these directions, I inferred that the storm had reached us from the northeast corner of the bay, and had followed a north-west or west-north-west course past Calcutta. What was my surprise, then, when accounts began to come in from other places in Bengal, showing that the course of the storm had been almost due north; and when, further, on plot-ting down the wind directions reported from other sta-

tions according to the hours at which they had been observed, I found that, instead of being at right angles to the radius vector, they were strongly inclined inwards; and such as, after making all allowances for their being only estimated directions and perhaps, therefore, a point or two in error, could be reconciled only with a sharp spiral indraught to and up to the central calm. Later on, when I obtained copies of the logs of ships that had been involved in the storm in its passage up the bay, I found that their wind observations, equally, were compatible only with spiral directions Unlike M Fave. I had no theory to support, and I submissively accepted the teaching of the evidence which lay so plainly before

This evidence is set forth on Plates I and II, of the Report drawn up by Colonel Gastrell and myself, which was widely distributed at the time to scientific bodies, so that, in all probability, a copy must exist in the library of

the Académie des Sciences

Since then, many other storms in the Bay of Bengal have been carefully investigated, and their full details embodied in Reports drawn up by Messrs Wilson, Eliot, Pedier, and myself Without a single exception, the evidence thus accumulated has been to the same effect as that of the cyclone of 1864, and these gentlemen have all arrived at conclusions similar to mine Thus, Mr Wilson says1 .- "The following rule may be used to determine the approximate bearing of the centre with as much accuracy as it seems to be possible to arrive at In the northern hemisphere, with the face to the wind, the direction of the centre is from ten to eleven points to the right-hand side", and, to quote only one of Mr Eliot's numerous references to this subject,? "The air is drawn into the centre [of a cyclone], but is not drawn directly to it. The particles move by a kind of spiral And he gives a diagram, followed path to the centre " by charts of the Balasoic cyclone of May 1886 and the Madras cyclone of November of the same year, as illustrative examples And Mr Pedler, in summing up the evidence of the False Point cyclone of September 1885.

says 3 — "It is therefore clear, from these autographic records, that there was a very strong indraught towards the storm-centre, and that for a considerable portion of the time, even when the storm-centre was comparatively close to Hazaribagh, the winds were part of a well-defined spral system. In fact, for a large part of the time they subtended an angle of less than 45° with the radius of the storm.

The records of five anemographs within the influence of the storm . show that the theory of the circular movement of winds in a cyclone, which was advanced by Reid and Piddington, and has been supported by some later writers, is utterly untenable considerable distances from the storm-centre the winds approach more to the radial direction of indraught towards the centre, as advocated by Espy, than to any circular movement. As the centre of the storm is approached, the circulation appears to become more defined; but even just outside the storm-centre there is no evidence to show that the direction is tangential "

The reports here quoted and many others, all leading to the same conclusions, have been communicated officially to a large number of scientisic bodies in Europe and elsewhere, and taken together they probably furnish the most copious and complete body of existing evidence relative to the cyclones of a tropical sea. Not long since I examined the whole of the charts given in these reports, in order to verify Mr. Wilson's rule (quoted above) for ascertaining the bearing of the storm-centre when th

[&]quot; "Report on the Midnapore and Burdwan Cyclone of October 15 and 15, 1864," p. 86 The trainer are as as the original Report." p. 14,1860.
3 "Indian Meteorological Memora," vol. 1, Part. 2, p. 37. The harometric passing seconded when the centre of this vious was passing kilose Douts Lighthouse is the lowest that has ever been observed at the sea-level

local wind direction is the only datum available, and I found that in the north of the Bay of Bengal, as the mean result of 132 measurements, the angle included between the wind arrow and the radius vector of the vortex was 122" (or 32" greater than a right angle), and that of twelve positions within 50 miles of the storm-centre, that is to say, in the inner circle of the hurricane, 123° In the south of the bay it was 7° greater. Prof Loomis, taking into account the land as well as the marine observations, and all barometric depressions, whether storms or otherwise, obtained an angle 25° greater, and dif-fering only by 33° from the radial direction. It is hardly necessary to refer to Prof Loomis's results of his examination of the Manilla cyclone of October 1882, which gave an angle of 1183, or to Mr Meldrum's work on the cyclones of the South Indian Ocean, which has already been quoted by Mr Archibald in his article in NATURE, mentioned above. All testify uniformly and in the strongest manner to the sharp spiral indraught of the winds in tropical cyclones, so that, as Prof Loomis has truly remarked, "we thus see that tropical storms are spouts and not cyclones, and it is unfortunate that the spouls and not cyclones, and it is unortained and the term cyclone should have been ever adopted. In this view I fully agree, and I make M Faye a present of the admission, that in an etymological sense, if in no other, Mr. Piddington's typical cyclones are not cyclones at all.

With all these results of a quarter of a century's expersence present to my mind, when a gentleman holding the high position of M. Faye resterates the assertion that the winds of tropical cyclones blow in circles, and that if ever they are found to blow spirally inwards such instances are not true cyclones (in the ordinarily accepted, i.e. denotative, meaning of the term), the impression I receive is somewhat such as M Faye would probably experience were some equally eminent scientific authority to assert in his presence that the Ptolemaic system truly represents the relative movements of the sin and planets, and that the heliocentric scheme of Copernicus is a "prétendu système." If, indeed, M Faye prefers to avail himself of the admission made above, to relegate Mr Piddington's typical cyclones to the category of "prétendus cyclones," and therefore to exclude them from his theory, my present argument falls to the ground, but in that case his cyclone becomes the mere abstract definition of a term, and it remains to be shown that there is anything corresponding to it in Nature That, however, in his latest communication to the Comptes rendus, he intended his assertions to

apply to these tropical cyclones is abundantly apparent
Can it be that M. Faye is unacquainted with the mass
of original evidence embodied in the Indian cyclone reports, in Mr Meldrum's writings on the cyclones of the South Indian Occan, and with Prof. Loomis's work, in which these and many others are discussed? It would indeed seem so, since in none of his writings have I ever seen any reference to any other Indian author than Mr Piddington, and even in his case it is difficult to believe that M Faye has done more than simply accept Mr Piddington's conclusions, without attempting to verify them by an examination of the original data. But if this But if this be really the case-if he has taken so little pains to ascertain the fundamental facts, and to test the soundness of his speculations by an appeal to the evidence of the last twenty-five years-it is indeed strange that he can put forward confident assertions on a matter with which his acquaintance is so imperfect, and that he can disseminate statements that are demonstrably erroneous, and may be fraught with danger to the lives and property of those who accept him as their guide, backed with the high authority that must necessarily attach to his name

It is a far from edifying spectacle to see such a man, in his latest communications to the Comptes rendus, quoting with complacency any isolated passage in the writings of leading meteorologists which seems to promise some

would tell against it. That such cyclones as originate beyond the tropics are, in the first instance, movements of the higher atmosphere, has been rendered very probable by Dr Hann's demonstration of the temperature relations of cyclones and anticyclones, but nothing that Dr. Hann has ever written has shown that he is in the least inclined to accept M Faye's strange hypothesis of a descending current as the leading feature of cyclones and tornadoes That the clearing of the skies in the central calm of a tropical cyclone may be due to the descent of a certain amount of air, although not decisively proved, is yet not improbable; but what would be thought of a man who, standing on a river bank, and seeing an upward current in the back-water immediately below him, should shut his eyes to the broad stream beyond, and assert, on the strength of his observation, that rivers flow from the sea to the mountains? Yet such, and no other, is the relation of this descending current to the great body of the cyclone All may admit, with Prof von Bezold, that there is much in the views hitherto prevalent as to the origin of cyclones and anticyclones that requires modification, and it may yet be long before these phenomena are fully and satisfactorily explained. There are many points of difference between the storms of the tropics and those of the temperate zone which seem to show that the forces that are principally active in the former play but a secondary part in the latter certainly there is no apparent tendency on the part of the leading meteorologists of Europe and America to accept M. Faye's tdolon specus as a true theory of cyclones and tornadoes, nor is it in the least likely that such will ever be witnessed HENRY F BLANFORD

NOTES

I HI Alreagements for the meeting of the British Association are now nearly complete. In a former note we referred among other matters to the exensions. We now learn that among them the organization of the pedestrian excursions to the Black Mountains is so far advanced that the detailed programme is now ready, and can be obtained by application to the Local Secre-

THE Royal Archeological Institute of Great Britain and Ireland opened their annual meeting in Edinburgh on Tuesday. At noon there was a reception of the members in the National Portrait Gallery by the President and Council of the Society of Antiquaries of Scotland The inaugural meeting took place in the lecture hall of the Royal Geographical Society Sir Herbert Maxwell, on taking the chair, remarked that the closing years of a century naturally suggested the process of stocktaking, and as they had arrived at the last decade of a century which claimed to have witnessed beyond all precedent the accumulation of scientific knowledge, it was not unnatural that they should direct inquiry into the standing obtained by that particular branch of science in which they were all concerned After a brief summary he stated that one of the problems which was pressing upon antiquaries at the present time was that relating to those mysterious rock sculptures which from time to time were found in increasing numbers all over Scotland They bore a striking resemblance to similar rock sculptines found not only in Scandinavia and Central Europe, but in such remote parts of the earth as Asia, and Northern, Central, and Southern America. They could hazard no guess even at the race by whom they were made, still less at the object of their authors. All they could do was to record the discovery of them with careful drawings, and wait till perhaps light would flash upon them from the habit of some uncivilized support to his toltering theory, and ignoring all that tribe or from a passage in some hitherto unnoticed writer. In the evening Dr. John Evans opened the Antiquarian Section with an address on the progress of archieology. The address covers the whole ground from Christy and Lartet's researches on the Dordogne to the Assyrian tablets.

By an Imperial Decree of June 8, the Gold Medal for Art and Science was bestowed by H I W the Emperor of Austria on Dr. R Bowdler Sharne, of the British Museum

At the graduation ceremony of the University of Edinburgh, held on the 1st int, the Cameron prize was presented to Fir. Ferrier, F.R. S., by Prof. France. Prof. France sud that Dr. Ferrier's researches had gaused for han a well mentied fame throughout the whole cruised world. He had contributed to the allevation of suffering in some of its most distressing and panful manifestations, and therefore the Senates had thought that they were fully justified in awarding to him the prize, which had been founded for the recognition of important and valuedic contributions to practical their passes of the pleasure in announcing further that Dr. Ferrier would, early necessarily mentioned the present sensing the prize of the professional properties of the prize o

AT a meeting of the Academy of Medium of Parts on the 28th alumo, Sr Joseph Fayer, of I ondon, and Dr. Batenan, of Norwah, were elected Associates of the Academy These gentlemen had both been for some years Correspon lang Members of the Academy, but they shared the Membership with only six other members of the profession in this country, vz. 's 'I' prince Paget, Bart, Sr Richard Owen, 'sı Joseph Hooker, 'sir Thomas Longuone, Dr West, and Sır Speace Welst, Burt

DR THORNE THORNE, F R S, has been elected a Corresponding Member of the Royal Italian Society of Hygiene.

PROF DU BOIS REYMOND has been elected Dean of the Medical Faculty of the Berlin University for this year. He has already more than once filled this post. Prof. Foerster, the astronomer, has been chosen Rector of the University

HER MAIRSTY's Commissioners for the Exhibition of 1851 have offered nomination to Science Scholarships for the year 1892 to the following Universities and Colleges The Scholarships are of the value of £150 a year, and are tenable for two years The scholars are to devote themselves exclusively to study and research in some branch of science the extension of which is important to the industries of the country - University of Edinburgh, University of Glasgow, University of Aberdeen, Mason College of Science, Birmingham , University College, Bristol, Durham College of Science, Newcasile, Yorkshire College, Leeds, University College, Liverpool, Owens Col lege, Manchester; University College, Nottingham, Firth College, Sheffield, University College of North Wales, Bangor , Queen's College, Cork , Queen's College, Galway , University of Toronto, University of Adelaide, University of New Zealand.

In has been decided to perpetuate the memory of the connection of Dr. Leidy with the University of Pennsylvana by raising a find to endow the Chair of Anatomy and to found a memoral emission. Dr. Leidy was Professor of Anatomy for thirty-nine years, and his devoted services will be suitably recognized by connecting his name with the chair which he so long adorned.

THE arrangements for the World's Fair at Chicago seem to be advancing quickly. Seeing that so much benefit to cience may be anticipated from the comparison of the best instruments and methods of working in use in different countries, which

such exhibitions render possible, it seems a pity that political questions may render them less representative than might be wished. The New York Nation refers to the reluctance of French manufacturers to take part in the World's Fair, due to the bad feeling created by the McKinley Bill, and to the belief entertained that any expense incurred in exhibiting good, would be lost by reason of the commercial re-trictions which that measure was intended to create and his created. "Nobody cares to spend his money for mere purposes of show. Unless trade follows as a consequence of the exhibition, the money will be sunk. . It does not advance matters, or help on the Fair, to show that both countries are wedded to a faise system It should serve, however, to open the eyes of people on both sides to the absurity of inviting each other to show their goods, and then creating barriers to prevent each other from buying and selling. Imagine an American McKinlevite meeting his French brother at a World's Fair in Paris or in Chicago, and exhibiting to the latter a choice lot of provisions put up in Mr Annour's most approved style, while the latter exhibits a fine assortment of woollens, silks, gloves, &c. If they could look in each other's faces without laughing, they must have a gravity exceeding that of two Roman augury. Ordinary self respect ought to teach the commercial classes of both countries to keep away from World's Pairs until they learn the A B C's of trade "

l'eclinical instruction in the provinces is F pur a muse growing apace, smill thanks to our state-men and legislators, for we one to an accident the possibility of meting the met crying needs of the time We may refer to what is going on in Lancashire as an indication of the general awakenment The total sum available for technical ins auction is £40,391, and, after the sums afready guar inteed by the County Council and some special amounts now in question are taken into account, there is a balance of about 1,29,000 to be dealt with, which the committee of the Council recommend should be apportuned between the urban and rural districts of the administrative county on the dual basis of rateable value and population. The committee recommend that a director of technical instruction be appointed at /500 per annum, with travelling expenses, that £3600 beset abait to provide twenty scholarships not exceeding 4.60 each for a term not exceeding thice years, apportioned as follows-eight for science (tenable at Owens College, Liverpool University College, or other approved public institution), two for art, four for commercial subjects, and six for the science of agriculture, including horticulture, that £1200 be set apart for providing eighty exhibitions of (15, tenable for one year at Owens College and I iverpool University College evening classes, or at some approved technical, commercial, or intermediate school, to be apportioned as follow--thirty two exhibitions for science, eight for art, sixteen for commercial subjects, and twenty-four for agriculture, that £2000 be set apart for founding travelling scholarships and free studentships of £1 to £10 to assist students in attending technical schools, that the various urban and rural sanitary authorities, through or in conjunction with any district committees that may be appointed, be permitted to nominate candulates for the above, two thirds of whom shall be children of parents whose incomes do not exceed £300 per annum, that all the scholarships and exhibitions be opened to students of both sexes resident in the county, that a sum not exceeding £1000 be granted for the purpose of aiding University Extension lectures, that a sum not exceeding £500 be granted to carry out the arrangements with the council of the Harris Institute in Preston for the promotion of technical instruction in agriculture, and that a sum not exceeding £ 1000 be granted for staff and office expenses. The migratory dairy school having been much appreciated, arrangements have been made to start a second school at Ulverston on August 11. A scheme for agricultural

instruction is also being arranged (estimated to cost £500 per annum), but the details have not yet been finally settled.

THE managers of the New Gallery announce a "Victorian Exhibition," covering the fifty years of Her Majesty's reign from 1837 to 1887. As in the case of the preceding exhibitions, it will contain pictures and other records of events illustrating the history of the Royal Family and of the nation, and it will contain, above all, a series of portraits of the illustrious men and women who, in so many different ways, have made their mark upon the age We gather from an article in the Times that science, in this of all reigns, is not likely to fall behind. We are promised pictures of Charles Darwin, Faraday, and Sir John Herschel, of Lyell and Murchison, of the two Stephensons, of Fox Talbot, one of the inventors of photography, and of Wheatstone, one of the inventors of the telegraph. The article adds that "it would be easy to quadruple this list, supposing the eminent men of science to have had the time and the vanity to sit for their portraits." We agree

THE Pall Mall returns to the charge on the subject of the imagined unpopularity of the British Museum, and states that although the evening openings have so far been a failure, and a very costly failure, the first installation of the electric light costing over £17,000, the problem is being carefully considered It is also stated that it is an open secret that for some years past the Trustees have been unanimous in favour of Sunday opening. which, as they have more than once pointed out, would entail little or no extra work on the officials, but merely change of work for a few policemen. Among the things that are wanted are certainly continuity in the hours during which the Museum is open on any one day, and the possibility of obtaining some decent refreshment If in these matters the Trustees will imitate he arrangements at the South Kensington Mureum, we believe the attendance will be increased-the attendance of workers certainly will

We are requested to state that the designs submitted in competition for the completion of the buildings of the South Kensington Museum are now on view at that Museum from 10 till 6.

DURING the whole month of July little variation to the state of Vesuvius was observable; the lava flowed steadily on, and had at one time extended down the Fossa della Vetrana, nearly opposite the lodge and gate of Messra. Cook's private road to the Vesuvian railway, but immediately cooled, and again started flowing much nearer its source At the summit of Vesuvius the vapour appeared to issue almost as in the normal state of the mountain, except for momentary interruptions and occasional ejection of dust and sand Dr Johnston Lavis, who has recently visited the scene, sends us the following details -"On July 30, I again visited the top of the great cone. The central crater has considerably enlarged, and has now an elliptical plan, with the major axis directed north west to south east, but this form has been derived from its original circular shape by the greater destruction of the lips towards the south east. The edges were in a most unstable state, and attempts at photographing the interior were accompanied by considerable danger, and required many precautions On the inner walls I was, however, able to make out several dykes besides the hollow one that has supplied the great eastern rift for its several eruptions from 1881-82 to 1890. These may be enumerated as directed north-east, north north-west, probably the dyke formed at the commencement of this eruntion . north-west, south-west, probably the cooled upper extremity of the lava sheet filling the south-west fissure which I have so often mentioned; and lastly, the hollow dyke to the south-south east. which supplied the lava of May 1885, is again exposed. There may be other dykes, but the large amount of vapour filling the crater, and the danger and impossibility of approaching the

edges in most parts, prevent a very detailed examination. So far a I could make out, the situation of the vent is quite to the south-east of the erater bottom, so that this fact, combined with the prolongation of the crater in that direction and the existence of numerous radial fisures, would indicate that the epistence of numerous radial fisures, would indicate that the general tendency is for the next lateral disraption to take place towards Pompen, or Torre Annanatia. On July 30 the laws was flowing very slowly just at the junction of the Atrio del Cavildo and the Fossa Verrana. To an experienced observer the whole state of the mointain is still very untable, and a fresh outbard might occur at any moments, shough the voto from any greatest proteam of the control of the control of the control of the were felt at the lower rallway station, showing that inportant fraduring, injection, or other dynamic disturbances were taking place in the great cone,"

WE have received from Mr C Mostyn an interesting letter on the well known appearance of the green ray at sunrise or sunset caused by the refraction of the air He states -"This 'green ray' is seen to best advantage at sun rise, owing I imagine to the eye not being wearied with watching the previous glare, as is apt to be the case at sunser At the same time, I had many very satisfactory observations at sunset, one in particular, when we were running before a very heavy sea in the Southern Ocean, and the 'green ray' was seen no less than three times in as many seconds, as the ship rose and fell on the huge waves causing as it were two sunsets, with a sunrise between them The best displays took place when the refraction near the horizon way of such a character that the sun assumed a balloon, or vase, shape as he came close to the sea-line When, on the contrary, the sun appeared flattened out in its horizontal diameter, the green ray was cuther entirely absent, or was seen only in an indistruct and uncertain manner "

SIE FIWARD WATKIN having now, we pressume, cured unpontenshity on the many lines of railway which he is highly paid to manage, is aguin turning his attention to Snowdon. It will live be remembered that he proposed in the first instance to erect an astronomical observatory there. This, of course, was relictions, we are now told that the authorities of the Timity House have expressed warm approval of his more recent proposal to place an electric light on the summit. The Filder Brechric consider that the light should prove an invaluable addition to those already erected round the North Wales coact for the guidance of manners. Six Fidward hopes to have the light burning before Christ max.

Titte Directors of the Crystal Palace, in deference to the wish of the Leterical Trade Section of the London Chamber of Commerce, have decided to postpone the opening of the Elec trical Exhibition from November 1891 till January 1, 1894, on which date the Exhibition will be formally opened.

WE learn from the Photographic News that the great progress that has been made in the methods by which rapid movements can be analyzed is well seen in a series of photographs lately taken by Anschutz, of Lissa, who has already given to the world some of the best instantaneous pictures ever taken. The subject of the pictures at present under consideration is a dog jumping over a small bush. In the act of making one jump the animal has been photographed twenty-four separate times, and each picture is not a mere silhouette, as was the case with Maybridge's first attempts of this kind, but a little picture showing half-tone and detail Some of the attitudes are, of course, comie in appearance, for they represent phases of a movement which the eye is unaccustomed to, and cannot possibly appreciate. Notably is this the case in the commencement of the jump, when the dog's hind toes only touch the ground, and again at the finish of the jump, when his legs are gathered together in a

A GEMAN specialat, Dr. Cold, has recently yleaded for gyring young propile more sleep. A healthy minat sleeps most of the time during the first weeks; and, in the early years, people are disposed to let children sleeps as much as they will. But from six or sween, when school begins, there is a complete change as or sween, when school begins, there is a complete change hours, when he needs at least ten or eleven, and as he grows older the time of erest is shortened. Dr. Cold believes that, up to twenty, a youth needs mue hours' sleep, and an adult should have eight or nine. With insufficient sleep, the nervous system, and brain especially, not resting enough, and ceasing to work mortally, we find exhaution, excitability, and intellectual disorders gradually taking the place of love of work, general well-being, and the spint of instative.

THE Entomologist's Monthly Magazine, among much interesting matter, refers to the possibility of the destruction of some of the inclosures in the New Forest which have proved themselves to be among the happiers hunting-grounds of the entomologist

A REENT number of the Proceedings of the Academy of Natural Sciences of Philadelphia contains a paper on Echino derms and Arthropols from Japan, by Mr. J. E. Ives. The specimens described were collected by Mr. Frederick Steams, of Deroit. The new species of Echnoderms and Crustaces are enumerated. A new Opharima, a new cuts, and a new Pyenogonoid are described, and several species of star fishes their outsign and are illustrated. The places are admirable

BULLETIN No. 10 of the University College of Agriculture at Tokyo contains an account of some manuring experiments with paddy rice (second year) by D. O. Kellner, Y Kozai, Y Mort. and M Nagaoka. The principal purpose of the researches carried out in 1889, and reported in Bulletin No. 8, was to ascertain how much nitrogen, phosphoric acid, and potash can be consumed by rice from the stock of nutrients in the unmanured soil, and how much of them is needed in the manure for the production of a maximum crop if the three nutrients are applied in the most assimilable form. On the basis of the results then obtained, the present experiments were tried with the object of getting information on the following question: -(1) How much nitrogen, phosphoric acid, and putash is taken up from those plots which had not received the respective nutrients in the preceding year? (2) What is the effect of unrecovered phosphatic manure on the succeeding crop? (3) How much nitrogen can be supplied to rice by the preceding cultivation of a leguminous plant (Astragalus lotoides, Lam) for green manuring ? (4) What is the effect of various phosphatic fertilizers on rice? (5) What is the effect of various nitrogenous manures on rice? The work seems to have been carefully done, and affords a good instance of the way in which scientific questions are now being treated in Japan.

This July number of the Proceedings of the Society for Styphetal Research has reached us, and contains the following contributions —"On Alleged Movements of Objects, without Contact, occurring too in the Presence of a Pard Medium," by Mr. F. W. II. Myers, "Experience in Clairopance," by Dr. A Backman; and "A Case of Double Consciouspess," by Mr. R. Hodgwo.

At the Boursemouth meeting of the Bush Medical Association, a discussion on the subject of alcohol was immared by a paper by Dr. Samuel Wilks. In the course of his paper he stated that he had no acquaintance with anyogranic changes attribushel to alcohol in the lungs and kidneys, but it seemed that the digestive and nervous systems suffered "Physiologius had failed to demonstrate the chemical changes which it underwent in the body, and consequently it was impossible to say whether twas of the nature of a food or nor. No one had get seep a person who lived on alcohol, although there was evidence of persons taking large quantities of alcohol who yet preserved their weight with a minimum of food, and that supported the theory that, although alcohol was not nutritive in itself, it prevented the wear and tear of the body The opposite theory also existed, that alcohol acted as a spur to the nervous system and quickly wore it out. He could not disapprove of the use of wine and beer, if taken in moderation, by the masses of the people , but as to spirits or spirits and water, he had not made up his mind that they were in any way useful, and he seldom recom mended them. Dr Bucknill thought that the wise use of wine might cure some cases and be useful in others. Dr Norman Kerr said that alcohol was a poison, analogous in many respects to other poisons Sir Risdon Bennett agreed with Dr Wilk in not approving of spirits as a beverage lie believed it to be useful in fever and in some nervous diseases, but he did not think it desirable at the present time to lay down any broad principles with regard to alcohol with reference to the whole community

The Philadelphia Satellite states that, during the abortive attempt to cut a canal through the isthmus of Panama, as much as 200,000 ounces of quinne were used annually in combating malarial fever

ACCOUNTS to the Pharmacontual Tournat of Australus, the practice has been introduced into Victoria, on the recommendation of literon wor Mueller, of placing green branches of eucations of the property of th

THE Bulletin of the (American) Essex Institute just recrived contains an account of the annual meeting held la-t May, and a retrospect of the year, from which we learn that Mr Perley, in a lecture on "Old time Winters in Essex County," gave interesting particulars on many subsects, including weather. We give the following extract -"The lecturer spoke of the watch, church services, dres-, food, and schools of the early winter seasons, how the people spent their evenings, the winter employment of the people in cutting off the forest, sledding timber and wood, making pipe staves and barrel hoops, and, most interesting of all, the insutation of the old fashioned shoemakers' shops, of which nearly every farm had one a century 130 Women in those days engaged in spinning and weaving The holidays were referred to-Thanksgiving, Christnias, and New Year's , and the winter pleasures, such as sleigh-rides, dancing, spinning and quilting parties, and games, shuffle-board, coasting, skating, trapping, gunning, fishing, singing-schools, and girls' samplers He also spoke of the old modes of travel, snow slices, &c Nearly all the heavy teaming was done on sleds, and he mentioned the winter of 1768-60, when the travelling was so had that the farmers in the western part of the State could not get their grain and provisions to the coast to market Snow remained on the roads as it fell until about a century ago. Mr Perley then spoke of particular winters, that of 1641-42, when the Indian's said they had not seen the ocean so much frozen for forty years, of 1646 47, when there was no snow to lay, of 1696-97, said to be the coldest winter since the first settlement of New England; of 1701-2, which was 'turned into summer', of 1717-18, when the snow was from ten to fifteen feet deep and the drifts twentyfive feet, many one-story houses being buried, of 1740-41, said

to be the severest winter known by the settlers. Salem Harbour being frozen over as early as October, of 1774-75, a wonderfully mild winter, of 1779-80, when for forty days, including March, there was no perceptible thaw, and the snow was so hard and deep that loaded teams passed over the fences in any direction. arches being dug under the snow so that men on horseback could tide under them, and which was long remembered as the hard winter, of 1784-85, when, as late a. April 15, snow was 2 feet deep, and frozen hard enough to bear cattle, of 1785-86, when in the remarkable storm of November 25, the snow blew anto balls, one of which had rolled 76 feet, measuring 176 by 22 inches, of 1704-05, when the Betsey was launched in Salem on Christmas Day, the thermometer indicating 85° above zero at noon, and men and boys went in swimming , of 1801-2, when the Ulysses, Brutus, and Volutia, three Salem vessels, which sailed out of the harbour on a summer like morning in February. were all cast away at night on Cape Cod, in a terrible snowstorm, which continued a week. He also referred to more re cent seasons, and of the cold winter of 1856-57, when in one week in January was the coldest day by the thermometer ever recorded of late years, mercury in Salem 20° below zero : travel on the railroad between Boston and Salem entirely suspended from Tuesday morning to Thursday afternoon The recent mild winters were also alluded to "

IN the volume of Bayarian meteorological observations for 1800, Dr. C. Lang (the Director of the Service) contributes an article on the "Secular Variations of Damage by Lightning and Hail" He points out that in almost all recent investigations the conclusions come to are that during the last 50 years damage by lightning has much increased, but this is not borne out by his inquiry, but is probably owing to more attention having been paid to the subject recently. The numerous impurities introduced into the air of towns from hre-places, &c . would make it probable that they would be more liable to damage than country places, but exactly the opposite is the case, the ratio of damage to buildings in towns to that in the country being 1 2. This result is possibly to some extent due to the more numerous lightning conductors, and to railway lines in the towns He finds that the damage from hail shows a very probable connection with the period of sun spot frequency, but the secular range of the former points more particularly to the influence of temperature, so that the curve of hail-frequency shows, not only a minimum occurring with the II-year sun spot maximum, but also a period of about 35 years. The damage from lightning, on the other hand, does not show any connection with a secular range of temperature, but the minimum occurs with the maximum of sun spot frequency In other words, damage from hail seems to be more decidedly connected with terrestrial, and damage from lightning more with cosmical influence

THE application of science in the direction of domestic comfort scems to be advancing with great strides in the United States. The Nation, in ref. rence to the announcements that the inhabitants of Kansas City are about to be supplied with cool air in summer and warm air in winter through a system of pipes laid in the streets, and that the people of Framingham, Mass., are to be furnished with gas for heating purposes at the price of 50 cents a thousand feet, thus writes -" Thus the ends of the land are advancing in the art of living while the metropolis remains tationary, and is kept from falling behind only by incessant grumbling And yet the possibilities of comfort, of health, and even of cheapness revealed in these schemes are wonderfully alluring, and their realization would be prevented by no physical obstacles If we consider that wonderful work of human hands, the kitchen range, under the management of the regular cook, who knows how to put on all the draught at once and keep it on,

what aderourer of finel it is I. We need a cup of tex or a chop in summer, and a fire is kindled that would generate steam enough to drave an ocean nacer a unle upon her course, this kitchen is turned into a Tophet, the miscrable servants swelter in the apartments which their own stapidity and that of man-kind have rendered unnohmbathle, and their employers are rendered uncomfortable above. The extravegance of the Chinese, who, as related by Charles Lumb, at first thought it necessity to burn down a house whenever they wanted to roat a pag, an onting to ours." Has anybody ever calculated the annual watte caused by the above described "use" of the ordnary "kitchen range"?

An interesting paper upon the slow combustion of explosive gas mixtures is contributed to the current number of Liebig's Annalm by Dr Krause and Prof Victor Meyer The experiments described were made with electrolytic mixtures of hydrogen and oxygen, and detonating mixtures of carbon monoxide and oxygen. The first experiment consisted in heating in a bath of vapour of diphenylamine (305") a detonating mixture of hydrogen and oxygen contained in a U-shaped tube closed by mercury. The heating was continued without intermission for a fortnight, at the end of which time very little gas remained, almost the whole having slowly combined to form water. The experiment was then repeated in an apparatus constructed entirely of glass, and in which the use of mercury was avoided, except in a small manometer used to indicate the pressure. It was then found that no trace of water was formed at the temperature of diphenylamine vapour (305° C), at the temperature of boiling sulphur (448°) the amount of combination was exceedingly small; while at 518°, the boiling-point of phosphorus pentasulphide, a considerable amount of combination occurred, but no cusnititative rule could be deduced. In all these experiments the gases employed were most, and no particular care had been taken to remove the last traces of admixed air Now Bunsen and Roscoe, in their celebrated work on detonating mixtures of hydrogen and chloring, showed that regular results were only obtained when the film of air condensed upon the surfaces of the glass vessels employed was removed by allowing the gas to stream through the apparatus for several days previous to the experiment A fresh series of experiments were therefore made, in which these precautions were most rigidly observed a most complicated pieces of apparatus were constructed of glass throughout, which admitted of the drying of the gases prepared (in case of hydrogen and oxygen) by the electrolysis of hot water, so as to exclude ozone and hydrogen peroxide; and the pure gases thus obtained were allowed to stream through the series of bulbs united by capillary tubes for a fortnight, night and day, before the bulbs were sealed off at the capillaries. was found that, with pure dry gases, scarcely a trace of combination occurred by the fusion of the very fine capillaries As regards the temperature of ignition of electrolytic hydrogen and oxygen, or detonating carbon monoxide and oxygen, it was found that bulbs containing them do not explode when placed in boiling pentasulphide of phosphorus (518°), but do explode in vapour of stannous chloride (606°). The temperature of ignition lies, therefore, between 518° and 606° C The mode of explosion differs considerably under different circumstances. In case of explosion in vapour of stannous chloride, the bulb was never shattered, but a sudden appearance of flame within the bulb occurred, accompanied by a slight detonation, and in some cases the point of the capillary was blown off It is also astonishing how long one requires to hold such a bulb in a Bunsen flame before explosion occurs; it never occurs until the flame becomes coloured vellow, and the glass begins to soften, and frequently only causes a swelling out of the glass at the heated spot. Thinwalled bulbs, however, are sometimes shattered. In two cases it was noticed that the glass at the softened part was violently NATURE

forced in, owing to the previous heating having caused a large percentage of combination, and hence the production of a partial vacuum. Even after taking the rigid precautions to insure purity above described, no definite quantitative rule connecting the time and percentage of combination has been discovered, experiments performed simultaneously upon similarly treated mixtures yielding widely different results; showing that the irregularities of glass surfaces, even after removal of their airfilms, are quite sufficient to modify very sensibly the conditions under which combination occurs

THE additions to the Zoological Society's Gardens during the past week include an Egyptian Cazelle (Gazella dorcas) from North Africa, presented by Mr S C Stunders, a Ring-tailed Costs (Nasua rufa) from South America, presented by Mr Edward J Brown , two Herring Gulls (Larus greentatus). British, presented by Mr T. A Cotton, two White-bellied Sea Eagles (Hahatus havegaster) from Australia, presented by Mr Hugh Nevill, F & S. a Lesser Sulphur crested Cockatoo (Cacatua sulphurca) from Molucous, presented by Miss Partridge . three Barbary Turtle Doves (Turtur resoreus) from North Africa. presented by Miss D Bason; an Indian Cobia (Nata tripudians) from India, presented by Mr. H. F. Lindsay , two Hainessed Antelopes (Iragelaphus scriptus & 9) from Cambia, a -Paradoxure (Paradoxurus aureus) from Ceylon, two Giey Ichneumon (Herfestes griseus) from India, four grey Pairots (Psittacus erithacus) from West Africa, deposited

OUR ASTRONOMICAL COLUMN.

THE SPLCTRUM OF & LYR 1 -A study of twenty nine photo-THE SPECTRON OF BLYET —A SURY of twenty nine photo-graphs of the spectrum of B Lyra has led to some interesting results, noted by Prof E C Fickering in Astronomiche Nach-ichten, No. 3051 The spectrum of this star contains, in addition to the absorption lines, several bright line, the most conspicuous of which are about AA 486, 443, 434, 410, 403, and 389, to use a three figure reference. The lines near A 443 and 389, to use a three figure reference. The lines near A 443 and A 403, are two of the most promanent innes in the species of the Orion stars, and the remaining four coincide with the hydrogen lines; h. G. A. and a From the investigation it appears that these bright lines change their positions, so that sometimes they have a greater wave-length than the corresponding dark lines, whilst at other times the reverse is the case. In whilst at other times the reverse is the case. In some of the photographs several bright lines are double, and the dark lines are also not free from changes. This naturally led to the in quiry as to whether the changes were connected with the variations of the star's brightness. Starting from a minimum of tions of the stars originates statents from a minimum or brightness there is a maximum at 3d f.h., a secondary ninnmum at 5d 1th, another maximum at 9d 16h, and then the prin-cipal minimum is again reached after a total period of zdd zzh. The point of interest is that the fourture plates in which the secondary of the bright lines was increased were taken during wave-length of the prigot lines was increased were taken during the first half of this period of variation—that is, before the secondary minimum, whist on the eleven plates taken during the second half of the period the displacement was towards the blue end of the spectrum. And since the photographs extend blue end of the spectrum and since the photographs extend over more than four years, there can be fulled doubt that the displacements are intimately connected with the variations of the star's brightness One of the explanations suggested by Prof Pickering to account for the observed phenomena is that the bright lines are emitted by an object revolving in a circular orbit round the principal star, with a maximum velocity of about 300 miles per second, and completing its circuit in a period of 12d. 22h. The corresponding periastron distance is about 50,000,000 miles. If this be so, \$ Lyre is a binary of the \$ Aurige type, but differing from it in the fact that the component stars have unlike spectra The phenomena could also be pro-duced by a meteor stream, or by an object like the sun, rotating in 12d 22h., and having a large protuberance on it extending over more than 180° of longitude The study of the additional photographs which are being taken will doubtless elucidate the matter

THE POLARIZATION THEORY OF THE SOLAR CORONA .- In THE POLARIZATION THEORY OF THE SOLAR CORONA TIN | Paper read at the Royal Society by Sir William Thomson, D.C.L., the Publications of the Astronomical Society of the Paetfic, PRN, on June 11, 1891.

vol in No 16, 1891, Prof Frank H. Bigelow gives some further results of his investigations of coronal forms, and arrives at some new results. It can be shown that in the case of repulsion of matter in a spherical rotating body like the sun, two poles of repulsion are formed, and the body is polarized about an axis. Within the body the lines of force are parallel about an axis. Within the body the lines of force are parameted the axis of polarization, and their curvature outwide the surface may be calculated. Applying these considerations to the similar coronal forms exhibited in the eclipse photographs of July 1878 and January and December 1889, Prof. Bigglow hinds that the axis of polarization is at the variace of the sun about 43 from the axis of rotation, and taking the radius of the sun as 866,500 miles, the length of the axis to which the lines of force are parallel is 1,729,700 miles Its direction is fixed, and in 1878 parallel 18 1,729,700 miles 13s direction is need, and in 1070 miles 201 2, south pole = 301 6, which referred to the ascending mole of the unit's custor on the plane of the eclipte 1 138 1 349 85, 151 1 311 40, and 12 + 312 55 be taken as the number of revolutions, and the, angular excess during the three intervals between the dates of the above eclipses, the mean duly motion in longitude at the latitude of the coronal pole, 85 '5, 1- found to be 13 13307 From this the following periods of the sun's rotation in latitude 85° 5 is deduced—

Salereal period 27 41171d - 27d 9h 52m 52° Synodic period 29 6358oJ 29d 15h 15m 33%

The formula proposed to express the rotation period in different The formula proposed to express the rotation period in univerent solur lattitudes in $X = 86x^2 - 70^2$ and, where X is the mean daily motion in minutes, and I the lattitude. With this, x ele-ments it is possible to predict the positions of the coronal poles at any epoch, and in consequence the relative form of the coronal at the time, as seen from the earth. A comparison of the calcu-lated results and photographs, obtained during some recent echipses, the coronal properties of the properties of the properties of the coronal policy as universe of the coronal policy of the corona displays a striking concordance. The investigation "also serves to strengthen the conviction that the sun-spots are probably formed by the descent of material from the extremities of the coronal streamers, in a vertical direction upon the sun

OBSERVATIONS OF THE MOTION OF STRIUS - It the Berlin Academy of Sciences on June 4, Prof Vogel communicated some observations of the motion of Sinus in the line of sight Using the iron spectrum as the term of comparison with the spectrum of the star, it was found that the velocity of approach on March 22 was 196 geographical miles per second with respect to the sun With Indrogen comparison lines the velocity found was 1 73 miles per second

RUTERN OF FACKE'S COMPT - A telegram from the Lick Observatory to Prof Kruger, sanounces that Incke's [crodic comet has been observed on its return by Mr Barnard on August 1 9958 G M T, in the position R A, 3h 55m 20 6s, Decl 29° 597 1 N

ON SOME TEST CASES FOR THE MAXWELL-BOLTZMANN DOCTRINE REGIRDING DIS-TRIBUTION OF LINERGY

(1) MAXWELL, in his article (///ii/ Mor., 1860) "On the Collision of Elastic Spheres," counciles a very lemarkable theorem, of primary importance in the kinetic theory of gases, to the effect that, in an assemblage of large numbers of mutually-colliding spheres of two or of several different magni-tudes, the mean kinetic energy is the same for equal numbers of the spheres irrespectively of their masses and chameters, or, in other words, the time averages of the squares of the velocities of individual spheres are inversely as their masses the mathematical investigation given as a proof of this theorem in that first article on the subject is quite unsatisfactory , but the mere enunciation of it, even if without proof, was a very valuable contribution to accence In a subsequent paper ("I)ynamical Theory of Gaes," Plh. Trans. for May 1866) Maxwell hinds in his cutation (34) ("Collected Works," p 47), as a result of a thorough mathematical investigation, the same theorem extended to include collisions between Boscovich points with mutate forces. according to any law of distance, provided only that not more than two points are in collision (that is to say, within the dis-tances of their mutual influence) amultaneously. Tait confirms Maxwell's original theorem for colliding spheres of different

magnitudes in an interesting and important examination of the subject in §§ 19, 20, 21 of his paper "On the Foundations of the Kinetic Theory of Gases" (Trans. R.S. E. for May 1866)

(2) Boltzmann, in his "Studien über das Gleichgewicht der lebendigen Kraft zwischen bewegten materiellen Punkten" (Sitzb K Akad Wien, October 8, 1868), enunciated a large extension of this theorem, and Maxwell a still wider generaliza-Distribution of Energy in a System of Material Points "(Cam-Mixwell's "Scientific Paners," pp. 713-41), to the following effect (p 716) --

"In the ultimate state of the system, the average kinetic energy of two given portions of the system must be in the raiso of the number of degrees of freedom of those portions

Much disbelief and doubt has been felt as to the complete truth, or the extent of cases for which there is truth, of this proposition

(3) For a test case, differing as little as possible from Max-well's original case of solid elastic spheres, consider a hollow spherical shell and a solid sphere—globule we shall call it for brevity—within the shell I must first digress to remark that what has hitherto by Maxwell and Clausius and others before and after them been called for brevity an "elastic sphere." is not an elastic solid, capable of rotation and of clastic deformanot an elastic solid, capable of rotation and of classic deforma-tion; and therefore capable of an infinite number of modes of steady vibration, into which, of finer and finer degrees of notal subdivision and shorer and shorter penods, all translational energy would, if the Boltmann-Maxwill generalized proposition were true, be ultimately transformed by collisions. The "smooth elastic spheres" are really Boscowich point arous, with their translational ineria, and with, for law of force, zero force at every distance between two points exceeding the sum of the radii of the two halls, and infinite repulsion at exactly this We may use Boscovich similarly for the hollow shell with globule in its interior, and so do away with all question as to vibrations due to elasticity of material, whether of the shell or of the globule. Let us samply suppose the mutual action between the shell and the globule to be nothing except at an instant of collision, and then to be such that their relative com-ponent velocity along the radius through the point of contact is reversed by the collision, while the motion of their centre of mertia remains unchanged

nortia remanu suchanged (4) For heroly, we hall call the shell and interior globule of \$2,5 a footble molecule, or sometimes, for more heroly, a stamply an stom, or a single along his different construction or surface of the category and the radius or diameter or surface of the category and the radius or diameter or surface of the category and the radius or diameter or surface of the corresponding sphere (Tau explanation is necessary to avoid an ambiguity which might occur with reference to the common expression "sphere of action" of a

Boscovich atom) (5) Consider now a vast number of atoms and doublets, inclosed in a perfectly rigid fixed surface, having the property of reversing the normal component velocity of approach of any atom or shell or doublet at the instant of contact of surfaces, while leaving unchanged the absolute velocity of the centre of inertia of the two Let any velocity or velocities in any direction or directions be given to any one or more of the atoms or of the shells or globules constituting the doublets. According to the Boltzmann-Maxwell doctrine, the motion will become distributed through the system, so that ultimately the time-average kinetic energy of each atom, each shell, and each globule shall be equal; and therefore that of each doublet double that of each atom. This is certainly a very marvellous conclusion; but I see no reason to doubt it on that account After all, it is not obviously more marvellous than the seemingly well-proved conclusion that in a mixed assemblage of colliding single atoms, some of which have a million million times the surge storm, some of which have a militon million times to mass of others, the smaller masses will ultrastely average a million times the velocity of the larger. But it is not included in Maxwell's proof of single atoms of different masses [43] of his "1 lynamical Theory of Gaees" referred to above]; and the condition that the globules incloved in the shells are prevented by the shells from collisions with one another violates Tait's condition [(C) of § 18 of "Foundations of K T Gases"], "that there is perfectly free access for collision between each pair of particles whether of the same or of different systems." An independent investigation of such a simple and definite case as that of the atoms and doublets defined in 88 3-5 is desirable as a

test, or would be interesting as an illustration were test not needed, for the exceedingly wide generalization set forth in the Boltzmann-Maxwell doctrine,

(6) Next, instead of only a single globule within the shell of \$4. let there be a vast number. To fix ideas let the mass of the shell be equal to a hundred times the sum of the masses of the million million Let two such shells be connected by a pushmillion million. Let two such shells be connected by a pash-and-pull massless spring. Let all be given at reat, with the spring stretched to any extent, and then left free. According to the Boltzmann-Maxwell doctrine, the notion produced initially by the spring will become distributed through the system, so that ultimately the sum of the kinetic erregies of the globules within each shell will be a bundred million million times the average kinetic chergy of the shall. The average times the average kinetic energy of the shell in a average velocity of the shell will ultimately be a hundred-millionth of the average velocity of the globules. A corresponding proposition in the kinetic theory of gases is that, if two rigid shells, each weighing I gram, and containing a centigram of monatomic gas, be attached to the two prongs of a massless perfectly elastic tuning fork, and set to vibrate, the gas will become heated in virtue of its viscous resistance to the vibration excited in it by the vibration of the shell, until nearly all the initial energy of the tuning-fork is thus spent.

(7) Going back to the double molecules of § 5, suppose the internal globule to be so connected by massless springs with the shell that the globule is urged towards the centre of the shell with a force simply proportional to the distance between the centres of the two This arrangement, which I gave in my molecules embedded in ether, would be equivalent to two masses connected by a massless spring, if we had only motions in one line to consider, but it has the advantage of being perfectly isotropic, and giving for all motions parallel to any fixed line exactly the same result as if there were no motion perpendicular to it. When a pair of masses connected by a spring strikes a fixed obstacle or a movable body, with the line of their centres not exactly perpendicular to the tangent plane of contact, it is caused to rotate. No such complication affects our isotropic doublet. An assemblage of such doublets being given moving about within a rigid inclosing surface, will the ultimate statistics be, for each doublet, equal average kinetic energles of motion of centre of inertia, and of relative motion of the two eonstituents?

(8) If we try to answer this question synthetically, we find a complex and troublesome problem in the details of all but the very simplest case of collision which can occur, which is direct very simplest case of collision which can occur, which is direct collision between two not previously whenting doublets, or any collision of one not previously whenting doublet against a fixed plane. In this case, if the masses of globule and shell are qual, a complete collision consists of two impacts at an interval of time equal to half the period of free vibration of the doublet, and after the second impact there is separation without vibration, just as if we had had single spheres invent of the doublets

1 he "wenge relocity of a particle," prespectively of direction, i.e. the homes theories the sign of a particle, "prespectively of direction, i.e. the homes the wind of the square root of the time swrage of the square of its velocity containment, and, conversely, equal average homes energies of the two continuents, except in conversely, equal average homes energies of the two continuents, except in a conversely, equal average homes energies of the low continuents, except in a conversely, equal average homes energies of the low continuents, except in a converse of two masses, "m, m, personal continuents of two masses," m, m, personal continuents of two masses, "m, m, personal continuents of two masses, "m, m, personal continuents of two masses of tw

$$\kappa = U - \frac{m'r}{m + m'}, \qquad \kappa' = U + \frac{mr}{m + m}. \tag{1}$$
 whence

$$mu^2 \cdot m'u'^2 = (m - m)\left[U^2 - \frac{mm'r^2}{(m + m)^2}\right] - \frac{4mm'}{m + m'}Ur$$
 (2)

Now suppose the time-average of Ur to be zero. In every ca e in which this is so, we have, by (2), t me-av $(mn^2 - m'n z) = (m - m') \times \text{Time av} \left\{ U^2 - \frac{mm'r^2}{(m + nc)^2} \right\}$ (3)

Hence in any case in which
$$(m+m)^2$$
 Time-av $m'n^2$. (4)

$$1_{1000-8V} mu^2 = T_{100-8V} m'u^2$$
 . (4)

$$(m-m) \times \text{Time-av} \left\{ U^2 - \frac{mm'r^2}{(m+m)^2} \right\} = 0, . . (5)$$

and therefore, except when
$$m = m'$$
, we must have

Tume-av $(m + m)U^2 = T_1me-av \frac{mm'r^2}{M + m'}$. . (6)

which proves the proposition, because, as we readily see from (1), $\frac{1}{2}mm'^2l(m+m')$ is, in every case, the kinetic energy of the relative, motions, m-U, and U-m'.

But in oblique collision between two not previously vibrating But in oblique collision between two not previously viorating doublets, even if the masses of shell and globule are equal, we have a somewhat troublesome problem to find the interval between the two impacts, token there are sixe, and to find the final resulting vibration. When the component relative motion parallel to the tangent plane of the first impact exceeds a certain parasite to the tangent pains of the first impact exceeds a certain value depending on the radius of the outer surface of the shell, the period of free wibration of the doublets, and the relative velocity of approach, there is no second impact, and the doublets separate with no relative velocity perpendicular to the tangent plane, but each with the energy of that component When of its previous motion converted into vibrational energy the mass of the shell is much smaller than the mass of the interior globule, almost every collision will consist of a large number of impacts It seems exceedingly difficult to find how to calculate true statistics of these chattering collisions, and arrive at sound conclusions as to the ultimate distribution of energy in any of the very simplest cases other than Maxwell's original case of 1860, but, if the Boltzmann-Maxwell generalized doctrine is true, we ought to be able to see its truth as essential, trine is true, we ought to be anot to see its truth at essential, with special clearness in the simplest cases, even without going through the full problem presented by the details. I can find nothing in Maxwell's latest article on the subject (Camb Phil Trans., May 6, 1878), or in any of his previous papers, proving an affirmative answer to the question of 8.

(9) Going back to § 6, let the globules be initially distributed as nearly as may be homogeneously through the bollow, let each globule be connected with neighbours by massless springs, and let all the globules which are near the inner surface of the shell be connected with it also by inassless springs. Or let any number of smaller shells be inclosed within our outer shell, and connected by massless springs, as represented by the accompanying diagram, taken from a reprint of my Bal-timore Lectures now in progress. Let two such outer shells,



given at rest with their systems of globules in equilibrium within them, be connected by massless springs, and be started in motion, as were the shells of § 6 There will not now be the great loss of energy from the vibration of the shells which there great loss of energy from the contrary, the ultimate average kinetic energy of the whole two hundred million million globules will be energy of the wnote two nuncired million million grounts wat se-certainly small in comparison with the ultimate average kinetic energy of the single shell. It may be because each globule of § 6 is free to wander that the energy is lost from the shell in that case, and distributed among them. There is nothing vague in their motion allowing them to take more and more energy, now when they are connected by the massless springs. If we suppose the motions infinitesimal, or if, whatever their ranges suppose the interest are in simple proportion to displacements, the elementary dynamical theorem of fundamental modes shows how to find determinately each of the 600 million million and six simple harmonic vibrations, of which the motion resulting from the prescribed initial circumstances is constituted. It tells us that the sum of the potential and kinetic energies of each mode remains always of constant value, and that the time-average of the changing kinetic energy during its period is half of this constant value. Without fully solving the problem for the 600 million million and six co-ordinates, it is easy to see that the gravest fundamental mode of the motion actually produced in the prescribed circumstances differs but little in period and energy from the single simple harmonic vibration which the two shells would take if the globules were rigidly connected to them, or were removed from within them, and the other initial circumstances were those of § 6. But this conclusion depends on the forces being rigorously in simple proportion to displacements

(10)1 In no real case could they be so, and if there is any deviation from the simple proportionality of force to displace-Sections to to 17 added July to, 1891

meni, the independent superposition of motions does not hold good. We have still a theorem of fundamental modes, although, so far as I know, this theory has not yet been investigated. For so far as I know, this theory case not yet been investigated. For any stable system moving with a given sum, E, of potential and kinetic energies, there must in general be at least as many fundamental modes of rigorously periodic motion as there are freedoms (or independent variables). But the configuration of freadons (or independent variables) But the configuration of each fundamental mode is now not generally similar for different values of E, and superposition of different fundamental modes now the same or with different values of E, Ass now no meaning. It seems to me probable that every fundamental modes re-sentially unstable. It is not if Mas, well's fundamental mode re-sentially unstable. assumption 1 " that the system, if left to itself in its actual state assumption." That the system, it left to itself in its actual state of motion, will, sooner of itself, pass through every phase which is consistent with the equation of energy." is true. It seems to me quite probable that this assumption it true, provided the "actual state of motion." Is not exactly, as it position and evolucity, a configuration of some one of the fundamental modes of rigorously periodic motion, and provided also that the "system" has not any exceptional character, such as those indicated by Maxwell for cases in which he warns ' us that his assumption does not hold good

assumption does not note good

(11) But, conceding Maxwell's fundamental assumption, I do
not see, in the mathematical workings of his papers any proof of his conclusion "that the average kinetic energy correspond-ing to any one of the variables is the same for every one of the variables of the system" Indeed, as a general proposition its meaning is not explained, and seems to the inexplicable reduction of the kinetic energy to a sum of squares I leaves the several parts of the whole with no correspondence to any defined or definable set of independent variables What, for example, can the meaning of the conclusion 5 be for the case of a jointed pendulum? (a system of two rigid bodies, one supported on a fixed horizontal axis and the other on a parallel axis fixed relatively to the first body, and both acted on only by gravity) The conclusion is quite intelligible, however that is it true?), when the kinetic energy is expressible as a sum of squares of rates of change of single co ordinates each multiplied by a function of all, or of some, of the co ordinates 5 Con-older, for example, the still easier case of these coefficients

(12) Consider more particularly the easiest case of all, motion of a single particle in a plane, that is, the case of all, motion of a single particle in a plane, that is, the case of just two independent variables, say x, y, and kinetic energy equal to $\frac{1}{2}(1+y^2)$. The equations of motion are

$$\frac{d^2x}{dt^2} = -\frac{dV}{dx}, \qquad \frac{d^2y}{dt^2} = -\frac{dV}{cy},$$

where V is the potential energy, which may be any function of x, t, subject only to the condition (required for stability) that it is essentially positive (its least value being, for brevity, taken as zero). It is easily proved that, with any given value, E, for the sum of kinetic and potential energies, there are two determinate modes of periodic motion, that is to say, there are two finite closed curves such that, if m be projected from any point of other with velocity equal to $\sqrt{[2(k-V)]}$ in the direction, either wards, of the tangent to the curve, its path will be exactly that curve In a very special class of cases there are only two such periodic motions, but it is obvious that there are more than two in other cases. (t3) Take, for example.

$$V = \frac{1}{4}(a^2x^2 + \beta^2y^2 + cx^2y^2)$$
For all values of E we have
$$x = a \cos(ax - c)$$

$$y = 0$$

$$y = 0$$
and
$$y = 0$$

$$y = 0 \cos(\beta t - f)$$

as two fundamental modes. When E is infinitely small we have only these two, but for any finite value of E we have clearly an infinite number of fundamental modes, and every mode differs infinitely little from being a fundamental mode To see this let m be projected from any point N in OX, in a direction per-pendicular to OX, with a velocity equal to $\sqrt{(2E - \alpha^2 ON^2)}$.

Crannife Papers,vol. in p 744 ** \$^{1} Ibid., pp 714, 715 **
\$^{1} Ibid., pp, 716-776 **
\$^{1} Ibid., pp, 716-

After a sufficiently great number of crossings and res-crossings across the line XOX, the particle will cross this line very userly at the state at a term point. We are the state of the s

formulated in § 13; and an interesting problem is presented, to find (by the method of the "variation of parameters") a, c, b, f. slowly varying functions of t, such that

$$x = a \sin(at - c),$$
 $y = b \sin(\beta t - f),$
 $x = aa \cos(at - c),$ $y = b\beta \cos(\beta t - f),$

shall be the rigorous solution, or a practical approximation to Careful consideration of possibilities in respect to this case [cE/(a²B²) very small) seems thoroughly to confirm Maxwell's fundamental assumption quoted in § 11, and that it is correct whether cE/(a282) be small or large seems exceedingly probable, or quite certain.

(14) But it seems also probable that Maxwell's conclusion, which for the case of a material point moving in a plane is

Time av
$$t' = Time av y^2$$
, (

es not true when a' differs from B' It is certainly not proved No dynamical principle except the equation of energy,

$$(f' + v') = E - V$$
.

is brought into the mathematical work of pp 722-25, which gives by Maxwell as from 1. Hence on path and by desen gives by Maxwell as the season of for the path without nating the dynamics which enters into Maxwell's investigation, and we may draw curves for the path such as to satisfy (1), and curves not satisfying (1), but all travening the whole space within the path of the path with the path of the path with the path of the path with the path of the path bounding curve

$$\frac{1}{2}(\alpha^{n}1^{3} + \beta^{n}y^{n} + c1^{n}y^{n}) = 1,$$

and all satisfying Maxwell's fundamental assumption (\$ 11) (16) The meaning of the question is illustrated by reducing it to a purely geometrical question regarding the path, thus --Calling 8 the inclination to r of the tangent to the path at any point is, and o the velocity in the path, we have

$$x = q \cos \theta$$
, $y = q \sin \theta$, . (4)
and therefore, by (2),
 $q = \sqrt{|z(E - V)|}$, (5)

 $q = \sqrt{|\mathbf{z}(\mathbf{E} - \mathbf{V})|}$. Hence, if we call s the total length of curve travelled,

$$\int v'dt = \int q \cos^2\theta \, q dt = \int \sqrt{(2(F - V))^2 \cos^2\theta} \, ds \, ,$$

and the question of § 15 becomes, Is or is not 1 / de /(2(E - V)) cos' θ

$$= \frac{1}{5} \int_{0}^{\infty} ds \sqrt{\left(a(E - V)\right)} \sin^{2}\theta^{2} . \quad (7)$$

where S denotes so great a length of path that it has passed a where Successed agreat a length of pain that it has passed a great number of times very near to every point within the boundary (3), very nearly in every direction (17) Consider now separately the parts of the two members of (7) derived from portions of the path which cross an infinitesimal

area do having its centre at (1, y). They are respectively

and
$$\frac{\sqrt{(2(E-V))} d\sigma \int_{0}^{T} N d\theta \cos^{2}\theta}{\sqrt{(2(E-V))} d\sigma \int_{0}^{T} N d\theta \sin^{2}\theta} , ... (8)$$

where Nat denotes the number of portions of the path, per unit where two denotes the minimed $\frac{1}{2}x + \theta$ to t, which pass eitherwards across the area in directions inclined to a at angles between

the values $\theta = \frac{1}{2}d\theta$ and $\theta + \frac{1}{2}d\theta$. The most general possible expression for N is, according to Fourier,

$$N = A_0 + A_1 \cos 2\theta + A_2 \cos 4\theta + &c. + B_1 \sin 2\theta + B_4 \sin 4\theta + &c.$$
Hence the two members of (8) become respectively.

and
$$\sqrt{(2(E-V))d\sigma_2^2\pi(\Lambda_0+\frac{1}{2}\Lambda_1)}$$
 (10)

$$\sqrt{(2(E-V))/d\sigma_2^2\pi(A_a-\frac{1}{2}A_1)}$$
 surking that A_a and A_1 are functions of x , y , and taking

Remarking that A_s and A_1 are functions of x, y, and taking dx = dxdy, we find, from (10), for the two totals of (7) respectively

$$= \frac{1}{2}\pi \iint d^{4}dy (\Lambda_{0} + \frac{1}{2}\Lambda_{1}) \sqrt{[2(E - V)]} \Big|_{Y},$$

$$= \frac{1}{2}\pi \iint d^{4}dy (\Lambda_{0} - \frac{1}{2}\Lambda_{1}) \sqrt{[2(E - V)]} \Big|_{Y},$$
(11)

where $\int \int d^4x dy$ denotes integration over the whole space inclosed by (3) These quantities are equal if and only if | | dudyA1 vanishes, it does so, clearly, if a = B; but it seems improbable that, except when $\alpha = \beta$, it can vanish generally, and unless it does α , our present lest case would disprove the Boltzmann Maxwell general doctrine

Tfills Congress began its proceedings on Monday. Fourteen countries and forty-six (eographical Societies are officially represented. France has sent 73 delegate, (eremany 33, Austria Hungary 21, Switzerland 87, Italy 21, Russin 13, Grat Bintain 8, and spun, America, and the Netherlands two each Egypt, Portugal, Roumania, Greece, Norway, and Sweden are also represented There are, in addition, 150 Members and Associates who have not yet given in their names

M. Numa Dior. Swiss Minister for Foreign Affairs, bade the

delegates heartily welcome to Berne

Dr Gobat, Regicinagorath, Berne, President of the Congress, then delivered his managural address. In the name of the Geographical Societies of Switzerland he thanked the savan's

Cographical Societies of Swirerland he thanked the network present for responding to containly to their univitation.

Among the good work already done, Prof. Penck, of Yunna, his proposed the following revolution. —"This Congress on the geographical sciences, held at Berne, resolves to take the initiative in the presentation of a large map of the earth out a scale of one to a million, of which the various sections shall be delimited by lautades and longitudes, and, with this object, it appoints an international committee to determine the principles upon which the preparation of such map shall proceed. The members of this committee shall arrange that the various States engaged in preparing maps, the societies and periodicals pub-lishing original maps, and all private geographical establishments working in this field shall prepare detached sections of the said map, the sale of which shall also be regulated and arranged for (6)

by the committee. In the course of his address on the subject Prof. Penck oald a high tribute to the services rendered by Mr Stanley to the cause of geographical science, directing special attention to the fact that each of the explorer's expeditions across Africa had led to the preparation of from 20 to 30 maps

The proposal was referred to a committee of the Congress, which will report upon it

The subjects of an initial meridian and universal time, geo replaced eduction, orthography of geographical deduction, orthography of geographical names, lakes and glaciers, cartography, bibliography, meteorology, commercial geography, and voyages and travels are all to be touched upon in the deliberations

SCIENTIFIC SERIALS.

Journal of the Russian Chemical and Physical Society, vol. xxiii, No 1.—The chief papers are —On the molecular weight of albumen, by A. Sabanceff and N. Alexandroff. Several determinations were made on the method of Raoult, and gave an average of 14,276, the molecular weight thus appearing to be nearly three times as great as that deduced from the formula of Harnack (4730), and nearly nine times as high as that given in Lleberkuhn's formula (1612). The molecule contains nine atoms of sulphur, of which two are easily separated Sub-mitted to a temperature of 40°, the solution of albumen changes its properties, and its temperature of freezing is lowered —On the measurement of density of sea water, by Vice Admiral measurement of density of sea water, Makaroff. This elaborate work gives the results of measure-ments made on board the corvette Vitya: The value of various instruments used during the crulse is discussed in de-tail, and the following formulæ are given as expressing the results of the observations between the temperatures of o and For distilled water, the density is-

 $S_c = 0.9998795$ = $S_c(1 - 0.000061398t + 0.0000080021t^2 - 0.0000004586t^3),$

maximum density at 3° 972 For sea water, the density of which at 15° compared with that of distilled water at 4° is = 1 019, the formula is—

S, = 1'0207769

 $=5.(1+0.000022268t+0.0000069801t^3-0.00000004761t^8).$ maximum density at - 1° 570. For sea water, the density of which, also at 15°, is - 1 026, the formula is-

S.= t 0280936

 $= S_{1}(1 + 0.0000504537 + 0.00000628337^{2} - 0.000000038527^{3}),$ maximum density at -3'876. The last two formulæ gave excellent results for temperatures down to -5'. A comparison between the figures obtained by the I'll as and those obtained by the Challenger proved very satisfactory Finally, the author gives six most valuable tables of corrections Tables L and II. contain the corrections to be applied to S 15 for obtaining

 $S_{\overline{A}}^{\prime}$, and va_{ij} $v_{ij}v_{ij}d$, from -5 to +36°, for both distilled and sea-water Detailed interpolation tables are also given Table III contains the corrections due to the coefficient of dilatation of glass of the arcometer being not equal to the normal coefficient o 000028. The three other tables are for transferring densities S17 5 into densities S15 17.5

Bulletin de la Socilié des Naturalistes de Moscou, 1890, No 3-On the Protopirata centrodon, Ted, by H Trautschold (in German) The two Ichthyodornlithes from the Carboniferous of North America, described in J. S. Newberry's capital work upon the "Palæozoic Fishes of North America," Table xxxix, are very much like the Moscow fossils described by the author in are very much like the above ow to said elevative by the author in the above periodical (1884 and 1856) unler the names of Eddtus polopyrada, and later on, of Prodyrada centrodon—Geo-boanical notes about the flore of European Russas, by D. I. Litunoff (in Russian). The common Soutch fit (*Irius ylvistitu) grows, as known, chiefly on a sandy soil. However, it also appears in the hilly tracts of Europe and Asia, and there it grows upon a rocky soil, chiefly limestone. In the lowlands of Germany and Russia, the appearance of fir upon a rocky the Granday and Russa, the appearance of fir upon a responsible for the first product of the first product which are not met with elsewhere in the Russian plains, and with a number of endemic plants very rare in Russia as a whole. with a number of endemic piants very rare in Russia as a wnote. The author considers these rocky islands of fir-growths as surrivals from the pre Glacial period. The paper is full of most interesting botanical data and valuable remarks upon the con-nection of the glacistion of Russia with its present flora —The influence of friction upon the rotatory motion of celestal bodes, by Th Sloudsky (in French) The auxiliary theorems, upon which the principal theorem relative to the effects of friction is based, are demonstrated, the sun being taken as an illustration based, are demonstrated, the sun being taken as an illustration—On the outpin of enclopers in the embryo-position of certain Gymosoperms, by Miss C. Sololows (in French, with three between the formation of endosperms and of multicellular alboimen, and the partition of cells, especially as regards the Angomera The same researches are pruned by Miss Sololows as regards the Gymosoperms. The same researches are pruned they must be appropriately the same researches are pranted by Miss Sololows as regards the Gymosoperms, attention being paid to the part prighed by the success in the formation of partition walls.

Contribution to the morphology and classification of the Chlamydomonads, by Prof Goroschankin (in German, with two plates).—Prelionnary note upon inter glacial Jayers about Moscow, by N. Krichtsfowich

No 4 -Traces of an inter-glacial period in Central Russia, by assumed in Sprzograz and Strzograzia —On the molecular weight of the albumen of the egg, by N. Alexandroff (Russian).—Why the relative masses of the brain decrease in proportion to the inthe relative masses of the oran decrease in proportion to itse increase of the weight of the body, in the same type of Vertebrata, by Fernand Lataste (in French) — locathata (Ifpool) $\phi_{l}\phi_{l}h_{l}$, new species, by W. A Wagner (French, with p plate). This trap spader inhabits Middle Russia, and is especially numerous in the fields of Orel. Its thin trap, made of one sheet of web with some mould, is even more ingenious, for us shape, than that of the Clemian.

THE Nuovo Giornale Bolanico Italiano for July contains two articles of interest to lichenologists an account of the lichens of Brisbane gathered by Mr. F. M. Bailey, by Herr J. Mueller, and contributions to the lichen-flora of Tayenny, by Signor E. Baroni Signor L lanfani has an important paper on the morphology and histology of the fruit of the Apiace v (Umbellifer v), and Prof. C. Massalongo an account of the galls made by Acari on 45 species of trees, shrubs, and herbaccons plants, as well as of the insects which produce them

SOCIETIES AND ACADEMIES LONDON

Entomological Society, August 5 -Mr Frederick Du Cane toolman, F.R.S., President, in the chair —The President announced the death of Mr. Ferdinand Grut, the Hon Librarian of the Society, and commented on the valuable services which of the bonest, and commented on the visuable exvices which the decreved gentleman had rendered the Society for many years past—IP D Sharp, F R S, exhibited Julys selfge, w., from the Leastern Pyrenees, and stated that in the opinion in we as connecting link between the Thyanura and Permaptera. It calso exhibited puppe of Dytanus man quantity, one of these was perfectly developed, with the exception that it retained the Larwis head this was owing to the larva having received a slight injury to the head Dr Sharp also exhibited specimens of Ophonic puncti with and allied species, and said that Thomson's characters of the thric Swedish species, O functioilit, O bicwoilits, and O rectangulus, applied well to our British examples, and separated them in a satisfactory manner Thomson's nomenclature, however, would, he thought, prove untenable, as the distinguished Swede described our common punctically as a new species under the name of rectainties --Mr. It W Frohawk exhibited a bleached specimen of Epinepheliyannia, having the right fore-wing incaces specimeno it plus para para and a naving the right to rewing of a creany white, blending into pale smoky brown at the base, also a long and varied series of £ hypeanthus, from the New Forest and Dorking The specimens from the former locality were considerably darket and more strongly marked than those from the chalk. Amongst the specimens was a variety of the female with large lanceolate markings on the under side, taken in the New Forest, and a female from Dorking with large, clearly in the New Forest, and a remain from Lorking with large, clearly defined white-pupilled spots on the upper side M. Frohaws, further exhibited drawings of varieties of the pups, of E. hyperauthus, and also a large specimen of a variety of the female of Fuchlo. cardinumes, bred from own obtained in South Cork. with the hind wings of an ochreous yellow colour. Coloured drawlings illustrating the life-history of the specimen in all its stages were also exhibited —M. Sergé Alpheraky communicated a paper entitled "On some cases of Dimorphism and Poly-morphism among Palæarctic Lepidoptera."

EDINBURGH.

Royal Society, July 75.—Sir Dugliu Michigan, Pessident, in the chain—The Proper of Moroco gave an account of the new yacht which he has had fitted out for the study of the sea. He also described the mestigations which he has conducted same 1856, finst in the Bay of Cascon, and then around the Acroes and off Newfoundland. The latter investigations extended over three-years, and had as their object the investigation of the direction and speed of the surface current in the North

Atlanta: Special floats were thrown into the sea in three different places, and their progress was traced from place to place. As a preliminary rital 160 floats were thrown into the sea between the Anores and the Camary Victoria. Some of three seases were through the sease of t

luly 20 — The ITon Lord McLaren in the chair — Some additional observations, by Prof McIntondo, in the development and infe-hi-tones of the unrice food fishes and the distribution of their ows, were communicated. By means of warrows kinds distribution of the eggs, of the food fishes on our shores. They are found stall dispits, at the variete, and at the bottom. The floating eggs of the pitcherd and meckerel are chiefly found on the was of the city, whiting, and haddock are abstracted to the was of the city, whiting, and anddock are abstracted to the was of the city, whiting, and anddock are abstracted to the was of the city, whiting, and anddock are abstracted to the was of the city, whiting, and anddock are abstracted to the was of the city and the city of the ci

PARIS

Academy of Sciences, August 3 — M Dechartre in the heart — Experimental researches on the probable rive of guess at high temperatures and pressures, and in rapid movement, in the process of the company of the company

coefficient of expansion for solid phosphorus between 0° and 4° to found to be occopy; while for liquid phosphorus between 2° and 5° the coefficient is cocojó. The expansion is regular up to the melting-point, but an abruph change of phosphorus in the liquid and solid state is 1.045 — Study of the chemical neutralization of acids and bases, by means of their electric conductivities, by M. Daniel Berthelot. From the chemical neutralization of acids and bases, by means of their electric conductivities. When the chemical neutralization of acids and the section of the chemical neutralization of acids and the section of the chemical neutralization of acids and the section of the chemical neutralization and the chemical neutralization of the chemical of the plants which furnish them, by M. Ch. Comeron — On, the revisionace of the rake varies to the acids of which light by M. A. Chromoscopic analysis

Erratum -On line 36, p 336, instead of 0 t050 and 4 9720, read 1 1050 and 0 9720

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Elementary Source Lessons, Standard II W Heavit (Longmans)— Elementary Source Lessons, Standard II W Heavit (Longmans)— Standard Medorologyupes, yme ddison A Angel (Paire Gauther/Villan)— —Bash Francis II. Lenvita L A Meedith (Mycamilan)—Blustrations of the Ct. x xxiem of Unite J D Lowert (Alcomilian)—Blustrations of the Ct. x xxiem of Unite J D Lowert (Alcomilian)—Blustrations of the Ct. x xxiem of Unite J D Lowert (Alcomilian)—Blustrations of the Ct. x xxiem of Unite J D Lowert (Alcomilian)—Blustrations of the Ct. xxiem of Unite J D Lowert (Alcomilian)—Blustrations of the Normal Angel (Alcomilian)—Blustrations of the Ct. xxiem of the Ct. xxie

CONTENTS.

The International Congress of Hygiene and Demo-

PAGE

The International Congress of Hygiene and Demo- graphy	
	337
A Life of Darwin By Prof R Meldola, P.R.S.	337
Pines and Firs of Japan. By Dr. Maxwell T.	
Masters, FRS	339
Elementary Hydrostatics By Prof. A G Green-	
Our Book Shelf	34 I
Todhunter "Plane Trigonometry for the Use of	
	342
	342
McLennan "Cosmical Evolution a New Theory of	34-
	342
Williams "The Felescope an Introduction to the	34-
	342
Letters to the Editor:	.,
Silver Lodes and Salt Lakes -George Sutherland	342
A Magnificent Meteor Donald Cameron .	343
Bees and Honey dew - F. M. Burton	343
Dredging Products, -Alexr. Meek	344
The International Congress of Hygiene and Demo-	
	344
	346
Botanical Survey of India M Faye's Theory of Cyclones By Henry F. Blan-	347
ford, F.RS	348
	350
Our Astronomical Column:-	35°
	355
	355
	355
Return of Encke's Comet	355
Oh some Test Cases for the Maxwell-Holtzmann	
Doctrine regarding Distribution of Energy. (Illus-	
trated By Sir William Thomson, P R.S	355
The International Geographical Congress at Berne .	358
Scientific Serials	358
Societies and Academics	359
Books, Pamphiets, and Serials Received	360

THURSDAY, AUGUST 20, 1891,

THE CONGRESS OF HYGIENE

THE proceedings of this Congress were brought to a close on Monday, it being generally conceded that the importance of the conclusions arrived at and of the discussions on the more important topics were on a level with the numbers and eminence of the men of science taking part in the deliberations.

So far as space permits, we shall endeavour to give an account of some of the most salient subjects touched in the different Sections To get a general idea of the enormous area of the ground covered, it is only necessary to glance at the resolutions adopted It will be generally conceded that the members of the Congress are by these resolutions supplied with much food for thought in the interim which will elapse till the next meeting, which has been fixed at Budapest and for 1894

We note with the greatest pleasure that Her Majesty and the University of Cambridge have shown their appreciation of the honour done to the nation by the presence of so many foreigners, and that other bodies and individuals have not been lacking to render possible gatherings of a less severely scientific character than

the Sectional meetings

Her Majesty's action in inviting many of the most eminent representatives of different nationalities to Osborne-an action, we believe, suggested by the Prince of Wales-has been so well received, that one regrets that the nation has had to wait so long for such a precedent We regret it, not so much for the sake of men of science. but because the result has been that Royalty here has always lived apart not only from science but from national culture generally. The Queen, indeed, on the present system, never need know anything, except by some happy accident, of Britain's greatest men.

The party which went to Osborne left early by a special train, and were taken over from Portsmouth in the Queen's yacht. They were accompanied by Sir D Galton, Dr Poore, Prof. Corfield, and Mr S Digby Luncheon was provided at 2, and Her Majesty later on received the visitors, of whom the following is an official list .-

Austra-Hungury.—Dr. Emil Kusý, Ministerialrath, Sanitats referent, delegated by Minister of the Interior, Hofrath Franz Ritter von Cruber, Professor of Architecture, elegated by Imperal Council of Health; Dr. Ernst Hofrath Ludwig. Pro-fessor of Applied Chemistry a Harbological Institute, delegated by Minister of Finance, Dr. J Fodor, Professor of Hygene, University of Budapeut, delegated by Minister of Public Worship and Education.

Belgium.-M E. Beco, Secretary-General of the Department Bidgiam.—M. E. Beco, Secretary-General of the Department of Agricultur, Industry, and Public Works, delegated by Agricultur, Changara, and Commission Central de Statistyne de Bidgiage, del Academie Commission Central de Statistyne de Bidgiage, del Academie Royale de Médeane et du Consell Suprirear d'Hygiene Royale de Médeane et du Consell Suprirear d'Hygiene Smitzy, Council, delegated by the Danish Ocerement; Hara V Berg, Médical Director of the Navy, delegated by Daanh Naval Department, Sart. Od. Lauk, delegated by the Danish delegated by the Danish Consellation of the Medical Director of the Navy, delegated by Daanh Naval

Department.

Department.

Egyt — Dt. Hassan Pasha Ibrahim, Inspector Samitary
Department, and Professor of Hygiene.

France. — Dr. Etienne Jules Bergeron, Scorétaire perpétuel de
l'Académie de Mé lecine, Vice-Président du Comité Consultatif

d'Hygiène Publique, delegated by Minstry of Public Instruction de Paris, Princette de Comité Command de Paris, Princette de Paris, Princette du Comité Comutat d'Hygiène Publique, delegated by French Government; M. le P. Auguste Chaivesus, Membre de l'Institut, delegated by the Minstry of Chaivesus, Membre de l'Institut, delegated by the Minstry of Line and Commande de Comman

President du Conseil Manicipal de la Ville de Paris, delegate ol (14) of Paris, M. Roox, Pasteur Institute, Paris Gormany,—Dr. Buchner, Professor at Munich Gotte, dele-elegated by the Bavarian Government, Dr. von Coler, dele-desgated by the Bavarian Government, Dr. von Coler, dele-desgated by the Bavarian Government, Prof. Dr. von Coler, dele-teration of the Company of the Comman Empire; Dr. vol., Geheumrath, delegated by the Gorman Committee of Fraber, Geheim Medicinariah, delegated by the Parisan Govern-ment, Prof. Dr. W. Roth, President of German Committee of the International Congress, Generalari de SXI fx. S. Arméc Corps, delegated by War Minnstry of Sacony, Prof von Koch, "Addr-" —The Angely Mosse, Professor at Royal University."

Italy -Dr Angelo Mosso, Professor at Royal University, Turin, delegated by Italian Government, Dr. A. Corradi, Professor at Royal University, Pavia, delegated by Italian

Government Xipum — Dr. Shimpei Gotoh, Official Expert in Ministry of Interior, Tokio, delegated by the Government of Japan The Netherlands — Dr. G. van Overbeek de Meyer, Professor of State University, Utrechi, delegate of Government, Dr. W. Ruysch, Conseillier pour le Service Sanitaire, Department de

P. Ruysch, Conseiller pour le bervice Santiaire, Department de l'Inferieur, 'delegated by Government of the Netherlands Abumania —Dr. J. Felix, Professeur Université de Bucarest, Membre du Conseil Santiaire Supérieure de Roumanie, Membre en chef de la Ville de Bucarest, delegated by Government of

Roumania and City of Bucharest Kussa -Prof. Constantin Kowalkowski, Professeur d'Hyene à l'Université Imperiale de Varsovie, delegated by Imperial

University, War-aw

Journ — Don Just Vilanova y Piera, President of Health
Section of Royal Academy of Medicine, delegated by Spanish

(overnment Government.

Sweden and Norway — Dr Linioth, Chief Medical Officer,
Stockholm, delegated by Swedish Government and by City of
Stockholm, Dr Gotfried E Bentzen, Director of the Civil
Medical Service, Christiana, delegated by Government of Sweden and Norway

Servia -Dr Georgevitch, delegated by Servian Government. Statistics, delegate of the Swiss Government, Col Dr. Goldlin de Tiefenau, Instructeur en chef des Troupes Sani-

taire, Suisses, delegate of the Swiss Government

United States of North America — Major Alfred Woodhull,

Medical Department, United States Army, delegated by United States Government Army Department, Leut.-Col Philip S. Wales, Medical Director United States Navy, delegated by United States Government Naval Department; Dr. Salmon, Chief of Bureau of Annual Industry in the United States Department of Agriculture, delegated by Department of Agriculture, delegated by Department of Partment of P Agriculture.

India - Dr. Simpton, Santary Officer of Calcutta, Mancher ee Bhownagere, C. I. S., member of the Bharnager Jadecial Council, delegate of Mattagan of Bhornager, Dr. Frasard Council, delegated by Chancellor and Syndicate of Calcutta University of Copies - Dr. Solomon Fernando, delegate of Government of Council India -Dr Simpson, Sanitary Officer of Calcutta; Mancher-

Victoria .- Dr. Aubrev Bowen, delegated by Government of Victoria.

The visit to Cambridge took place on Saturday. The University authorities did all in their power to make it an agreeable one Not only did hospitality abound, but even in the Long Vacation degrees were conferred (this, unfortunately, is impossible at Oxford) on Drs. Brouardel, Corradi, and Fodor.

The peeches made by the Public Orator were as follows :--- `

DIGNISSIME domine, domine Procancellarie, et tota

Nescio quo potissimim exordio hospites nostros, qui de salute publica nupre deliberaverunti, senatus somine salutare debeam Ard 1900 conversus, illad unus diacrim sequi alcorim salut im praeclare consultatis, diacrim selezi alcorim salut im praeclare consultatis, quae vobis cordi sunt, gloriamur in Britannia certe Academiam nostram primam omnium aduvisse. In salutis publicae ministris nominandis valent pluminum diplomata nostram primam aliarum Academiarun, nello diacrimatis and praecia selezia della pluminum diplomata nostro honoritico decorare volunias. Nemini autemirum sit, quod viros medicinare in scientia libiteste suris mirum sit, quod viros medicinare in scientia libiteste suris mirum sit, quod viros medicinare in scientia libiteste suris pumi in libris quos de Legibus composuti, scripsisse recordamini populi salutem supremam esse legipuram estrograma.

(i) Primum onnium vobis priesento gentis vicinae, gentis nobiscum liberatis be ince temperatae amore coniunctie civerne gregrum, Parissorum in Academia medicinae forensis professorem preclarum, faculatis medicinae dictorem indefessum Olm Caesar omnes inedicinae dictorem indefessum Olm Caesar omnes inedicinam sedicinae dictorem indefessum Olm Caesar omnes inedicinae dictorem indefessum Olm Caesar omnes inedicinae dictorem indefessum Olm Caesar omnes inedicinae dictorem indefessum of the caesar omnes indefessum in caesar omnes in consociativi, corona nostra ob cives etilam in pace servizios libenter coronamis

Duco ad vos Paultim Camillum Hippolytum Brouardei

(2) Quo maiore dolore Austraaet (cermanae legatos illustres aosentes deuderamus, comaioregadon l'alande legatou margame praesseure sultanus s'Austraas Axademiae (Honontenia, nobiscum veter belanti une mobilitate, dende Panormi, denique Ticni in-ripa professorem, qui medicinae scentiam cum rerum antiquitus gestarum studius feliciter consociavit, quique in Italiae scriptoribus cimilis, non modo in l'occaccio ced chaum fil orquato atminis non modo in l'occaccio ced chaum fil orquato atminis professorem, qui margani de l'archive de l'ar

Roma ante Romulum fuit; non ille nomen indidit, "sed diva flava el candida, Roma, Aesculapi filia"!

Duco ad vos Aesculapi ministrum fidelissimum, ALPHONSUM CORRADI.

(3) Quis nescit upbem forentissiman quod Hungariae caput est, nome Billingui nutroquata, fluminis Danubii in utraque ripa esse positam. Quis noi inde nobis feliciter advectum esse gaudet salutis publicae professorem insignem, virum titulis plurimis cumulatum, qui etiam de Angliae salubinitate opus egregium conscriptis Idem, velut alter l'ippocrates, de aére, aquis et loris praeclare insignement de l'importates, noi l'ippocratis aemulum illustrem laurea nostra qualicunque in hoc templo honoris libester oriante.

Duco ad vos bacteriologiae cultorem acerrimum, Iosephum de Fodor.

The final general meeting of the Congress was held on Monday, under the presidency of Sir Douglas Galton

Manam Lupercalia, p. 374 of Bachrens, Frag. post Rem. NO 1138, VOL. 44] There was a large attendance, and among those present were nearly all the foreign delegates.

The Chairman, in opening the proceedings, after some pre-liminary remarks, said ... The success of the Congress, as an interliminary remarks, said —The success of the Congress, as an inter-national gathering, is due to the fact that we as a nation have many matters of interest to show to foreigners. I think I may say that the chief difference between our hygienic progress and that of our Continental neighbours is that, whilst they are especially fortunate in being able to pursue the theories upon which much of modern hygienic progress is based, with us public which much of modern hygienic progress is based, with us public opinion has hindered the study of many physiological questions, the solution of which depends upon the examination of living tissue. Hence, we at pre-ent are in this respect somewhat behind the Continental sehools, and we largely turn our attention to apply their theories to alleviate the wants of life. Hence we can show much do'unterest in practical byguene in matters both of construc-tion and adimmeration. Our methods of water supply and dramage, our various plans for refuse disposal or mithration, our costions hotpstala and ambulance systems present many miter esting features. The mrangements which are being made to introduce saminty knowledge and efficiency of workman-ters of the matter of the state of the state of the state title and the state of the state of the state of the title and the state of the state of the state of the state tall samintion of parts of our houses bygely depends, are deserving of consideration, and the health similiar trations of the large exists of Claegow and Manchester is expectally worthy of the study of our visitors. The organiza-tion of this Congress has differed from that of former Con-gress in the merested number of vections in an effective pro-gress in the merested number of vections in an energy and becomes more elaborate, the classification must necessarily be much of interest in practical hygiene in matters both of construc more detailed, and the number of Sections must either gradually increase or the Sections must subdivide. Independently of the merease or the sections must subdivide. Independently of the increased number of sections, it was found necessary to give two afternoons to the discussion of questions connected with the sanitation of our Indian Fuppire, which, for the first time in the human of the Cornel. history of these Congresses, was repie ented by a large number of delegates. The native Princes of India evinced deep sympathy with the Congress, and I trust that the interest which has been evoked in its object may lead to beneficial results in that great country . A principal object of the Congress is, without doubt, to afford to scientific men in different countries is, without doubt, to afford to scientific men in different countries the opportunity of conferring together. But it has another and most imprising the properties of the properties of the laws of health. Your President the other day saked the pertinent question—Why, if diseases are preventable, are they not pravented? The answer to that question is that, whilst an instructed answer to that question is that, which an information in minority may understand the importance of observing hygienic laws, a very large section of the community is careless of and indifferent to their observance, and consequently the portions of those laws which are individual and personal in their application are left a dead letter. Acts of Parlament are of little avail so long as the people they are framed to guide do not realize their value or importance, and it is quite certain that the only way to stamp out preventable disease is to educate every member of the community to feel the importance of the every member of the community to teet the importance of the laws of health. A great international Congress like his brings the subject prominently before the public and has a valuable influence on the country in which it is held. I have already detained you too long. But I must add, as chairman of the detained you too long. But I must add, as chairman of the organizing committee, that we have endeavoured to make the organizing committee, that we have endeavoluted to make the Congress useful and agreeable to those who have honoured us with their presence. The success which we have had is mainly due to our secretary-general (Dr. Poore), our foreign secretary (Dr Corfield), and, as far as India is concerned, to the energy of Mr Digby. The excellence of the social arrangements is of Mr Deby. The scellence of the social arrangements is entirely due to the organizing power and tast of the secretary of the reception committee, Mr. Malcolm Morris. But you will have an opportunity of thanking the executive before the end of this meeting. If there have been shortcoming, the organizing committee much regire them. The only apology we can offer is that a voluntary organization studiesly creates but strated requirements of the monature measured on Mondes members. requirements of the moment may have been somewhat strained at first by the number who appeared on Monday morning—a number far in excess of that which former experience led us to anticipate, and I would say in conclusion, in the words of our poet Frior—

" Be to our virtues very kind. Be to our faults a little blind "

The meeting next discussed the place of the next Congress; we have already stated that Budapest was fixed upon.

we have a fready stated that Budapest was freed upon.
You'se of thanks complied the business. Among these, Dr.
San That Hat Royal Highness the President be respectfully requested to convey to Her Majesty's gracious act in becoming of the Congress for Her Majesty's gracious act in becoming Patron of the Congress, and for the magnificent hospitality shown by Her Majesty to members of the Congress during their solourn in England

Prof. Kuy (Austrin) seconded the resolution.

Colonel Woodhall (United States) said that all members of Colonel Woodhall (United States) said that all members of the Congress must desire to express their gratitude for the way in which they had been received by that gracious lady Her Majesty the Queen, whose purity and dignity of life had enabled her to extend her empire of love and respect over even American

cuttens

The resolution was unanimously agreed to The resolution was unanimously agreed to His Excellency M Gennadius, the Minister for Greece, moved the following resolution —"That the best thanks of the Congress be dutifully tendered to His Royal Highness, the Prince of Wales, the President of the Congress, for the unitring interest which His Royal Highness has manifested in the Congress, and to which the success of the Congress is to be largely attributed."

attributed."
Finally, the Charman proposed a vote of thanks to the officers of the Association, whose unsparing work and indefaugablementy had so largely conduced to the aucers of the undersking. He coupled with the vote the names of Dr. G V. Poore, the hon-secretary-general, Prof W H Corfield, the hon foreign secretary-general, Prof W H. Corfield, the hon foreign secretary, and Mr Makiolin Morra, the hon secretary of the reception

eommittee
The vote was warmly received, and was unanimously adopted.

The Permanent International Committee have appointed the following International Sub-Committee to prepare a scheme for the organization of future Con-The Sub-Committee consists of Prof Dr Brouardel, Hon Ll. D Cantab (France), Prof Dr. Fodor, Hon LL D Cantab (Hungary), and Prof Corfield (England), to represent Hygiene, and M. Koiosi (Hungary) and Dr. Janssens (Belgium) to represent Demography.

It is understood that the Sub-Committee will consider the advisability of forming Permanent Committees in various country, the plan of having Committees outside the country in which the Congress is held having proved so successful in obtaining Foreign Members for the London Congress, at which it was adopted for the first time

This week we give an account of the work done in the Section of Preventive Medicine.

In this Section the President, Sir Joseph Fayrer, K.CSI, F.R.S., commenced the proceedings by delivering the following inaugural address:-

My first duty on occupying this seat is to make fitting acknowledgment of the honour which has been conferred on me, and to assure those to whom I am indebted for it that, as I apand to assure those to whom I am indebted for it that, as I appreciate the distinction highly, so, with the and of my colleagues in this Section, and the support of the meany eminent men of science who will take part in its work, I hope to discharge faithfully the important trust reposed in me. My next and most agreeable duty is to offer to all who honour us with their presence, or who propose by co-operation to forward the obpresence, or win progress, a most hearty welcome and cordial re-cognition of the interest in it manifested by their presence; to express a hope that the deliberations and conclusions which re-sult from their wisdom and experience may advance our know-ledge, and tend to enhance the welfare of the human race. This ledge, and tend to enhance the weinare of the numan race. This hope is based upon the universal recognition of the need of, and capacity for, improvement in the conditions upon which physical well-being, immunity from disease, and peolongation of life depend; and this is evinced by the assembling together in

this Congress of men of science from all parts of the world, who have devoted themselves to the great international, humanihave devoted themselves to the great international, numbers tarian purpose of ameliorating the conditions of mankind every where, so far at least as the application of the laws of health, and to some extent those of sociology, can affect this consumma tion. To all, then, we in this great city, who are interested in the progress of hygiene and demography, offer our cordial greet-ing, and express an earnest desire that our visitors may derivpleasure and benefit from their sojourn in London, and from the proceedings of the great assembly of which they form so im-

proceedings of use given assuming to portant a part.

Before I muste Dr. Caningham to open the first subject for discussion, it is right that I should make a few preliminary remarks on the general scope and objects of the work comprised in this section. I do not intend to occupy must of this section I do not intend to occupy must be this section. I which the service the processing the processing of the short and valuable time at our disposal by discussing any special subject, or by anticipating that which those who follow me may have to say, but shall confine myself to a brief follow me may have to say, but shall confine myself to a breet notice of the present aspects of preventive medicane, its recent development, how much it has operated and is now operating for the public good, how slowly but surely it is dispelling the cloud of ignorance and prejudice which has overshudowed and impeded the projects of sanitation, and how it is gradually imbuing only the public good of the good of the public good of the good of th the public mind with the conviction that prevention is better and often easier than cure, that health may be preserved, diease avoided, and life prolonged by the study and observance of certain well-known laws, which, correlating the individual with his surroundings, determine his well being when conformed to, deteriorate or prevent it when neglected, and should enforce the maxim, "Vententi occurite morbo." Unprecetorce the maxim, "Venienti occurite morbo." Unprecedented progress in human knowledge characterizes the preent century, and has not been wanting in prevenitive medicine. It is, however, daring the last half of it that advance has been most renarkable, whilst it is in a later part of that period, that it has so established itself in the popular mind as to have passed from the region of dombs and commendation. ave passed from the region of doubt and speculation into that of certainty It is now pretty generally understood that about of certainty It is now pretty generally understood that about one fourth of all the mortality in England is caused by prevent able disease, that the death-rate of large communities may be reduced much below that at which it has been wont to stand, the average duration of life may be made to approximate nearer to the allotted fourscore, and that the conditions of living may be greatly ameliorated. The clief obstacles to improvement have been ignorance and want of belief, a better knowledge of the laws of life and health, a more rational comprehension of the nature and causes of disease, are gradually but surely entailing improvement in the conditions of living and in the value of life, and the diminution and mitigation, if not extinction, of morbid conditions which have in past times proved so murrous or destructive to life In short, as Dante says

> " Se' I mondo laggiu ponesse mente Al fondamento che natura pone, Seguendo lui avria buona la gente " " Paradiso," viii , 142

Such are the subjects contemplated in the work of this Section and as far as time permits the most interesting of them will be discussed Those selected are of great importance in their relations to public health, let us hope that observers who have formed their opinions from experience in other countries and under different circumstances may throw new light on them

In the brief space of time at my disposal it would be im In the bref space of time at my driposal it would be impossible to give a continuous oulline of the progress of preventive medicine during the past, or to trace its growth and development out of ignorance and superstation to its for the progress of the section of the progress of the section of the best is now fairly grasped by popular sentiment, and that, though ignorance, opposition, and vested interests sell contacts the ground, progress is sure, and the light of sections is illuminating the dark places. It is now better appreciate the progress of th cated than it seer has been, that the causes which induce discuss and aborten life are greatly under our own control, and that we have it in our power to restrain and dimminis them, and to the control of the control

will indicate how much remains to be done. Did time permis, I might illustrate the progress of preventive medicine by constraint the state of England with its population of more than 20,000,000 during the Victorian with the England of the progress of England with its population of more than 20,000,000 during the Victorian with the England of the first of the england of the progress of the england of the progress of the england of the eng

364

If we turn to the preent, we find that great improvements have gradually been made an the mode of living, the houses are better constructed, the drainage and ventilation are more combeted or the present of the presen

If we moure into the effects of certain well-known diseases, we find that they are less severe in their incidence, if not less frequent in their recurrence. With regard to small-pox, annee the passing of the first Vaccinition Act in 1840, the death-though for the five years 1870–74 it was 47, thus showing that though for the five years 1870–74 it was 47, thus showing that there was still much to be learnt about vaccination. Entering fewer was not separated from typhus fewer before 1860, but since the state of the state

spheriae. The a fairly attributable to local staturery rather balant to occurs measures. Preventible disasts etill tally steely about 125,000, and, considering the large number of cases for every death, it has been calculated that 178 millions of days of labour are lost annually, which means £7,75,000 per annuary is also a rate lost annually, which means £7,75,000 per annuary andured by the still too numerous annually has been for the company of the lower town and the still consumerous annually and the expectancy of the lower plagues of the middle ages, yet in this century, now closing, other epidemics have made their papeasance incloser has four times visited us; fevers, empire diseases, and diphthera recently, and after leaving us last year, only to return with renewed virulence, caused in the United States a scortality and anisonst equal to that of the plague. Much has been dose, but much remains to be effected. Let us hope that the future may be more profile of unprovenent that the past; international philanthropy seems to say it shall be so. That disture may be more profile of unprovenent that the past; international philanthropy seems to say it shall be so. That compositions, and though we may never be able to reach the "four expected, but thece cannot be a doubt that we may diminish is uncidence, and though we may never be able to reach the "four towns which give neet to synotic dates, not even of induce which compromise otherwise the phyrical welfare of manking, but should not obviously make the past profile of receivance, involve over competition in various occupant of oversity of the province, professional, or mercanities, by which compromise otherwise the phyrical welfare of manking, but should be surgile for existence Or I might point to the crudescage of those psychical phenoment maintended to the influence of one mud upon another; this is a subject to the discussion of the three watchild notice of the dangerous centeredistics.

which may ensue from it Again, the abuse of alcohol, opium, chloral, and other stimulants and narcotics, and the evil consequences which may result therefrom, is also a subject worthy of consideration and will, no doubt, receive it in a communication which is to be brought before this Section

The poundle deleterous influence of untuken notions of education, as remoded in the over-pressure which is escrived upon the poung the predominance of estimations, their in-the titles that they are the best test of knowledge, whilst true mental culture is in danger of being neglected, and physical training, if no injuried, that the manual culture is in danger of being neglected, and physical training, the proposed, that the manual the scale of the physical properties are the present the properties of the physical preventive medicane, whose duty it is to safeguard the human fee from all avoidable causes of either physical or mental reservoir.

Though preventive medicine in some form has been practised uncer the days of Moss, yet it has received but intle recognition until a companitively recent period; when science developed and observation extended, medical men conditions in producing disease, and thus it was forced upon the public conscience that something must be done; and when philanthropust like John Howard devoted like and when philanthropust like John Howard devoted like existed—q in our galok, where the prisoners not only died of patrid fever, the result of ochleuc causes, but actually infected highest before whom they came recking with the contagon of the prisoner—not contagon of the prisoner—not contagon of the prisoner—not contagon of the prisoner—not sensitively measures gradually sense into opens and the contagon of the prisoner—not sensitively measures gradually sense into question of the prisoner—not sensitively that any selective progress was made; it was when Chadwick, Parkes, and others instituted the work by which they have exame the lasting gratuited of the

haman race that preventive medicine became a distinct branch of medical science. The sanistry condition of towns and communities is not dependent on the views or exertions of indimensions in the control of the contro

"Under the improved system of sanitary administration which now obtains, and is gradually developing to a greater state of perfection, the sanitary administration of very district in the country is intracted to the cure of duly qualified leath officers—country is intracted to the cure of duly qualified leath officers—and from which better still may be anticipated. The records of the pass fifty years prove the influence extented by sanitary measures on vital statetic. The first reliable tables from which the pass fifty years prove the influence extented by sanitary measures on vital statetic. The first reliable tables from which the vast for males 3 gog years, for females 11 to 1850 it had increased to 41 35 for males and 44 66 females. It is, whom also that the expectation of life increases every year up to the fourth year, and decreases after that tables, that dare that age it is less. The improved sanitation swers more than they were at the time of the first table, which accounts for the expectancy of life for stall men being less. Women remain more at home, where the better sanitation talls, and are not expectancy of life for sall men being less. Women remain more at home, where the better sanitation talls, and are not expectancy of life for sall men being less. Women remain more at home, where the better sanitation talls, and are not expectancy of life for sall men being less. Women remain more at home, where the better sanitation talls, and are not decreased death size. Let us compare the death rates of a decreased death size. Let us compare the death rates of England during past times with the present, whether they be a life entire the point in question of these.

	DEATH	-RATE	
1660-79 1681-90 1746-55 1846-55 1866-70	80 per 1000 42 I ,, 35 5 ,, 24 9 ,, 22 4 ,,	1870-75 1875-80 1880-85 1885-88	20 9 per 100 20 0 ,, 19 3 ,, 18 7 ,, 17 85 ,,

In some parts of England, where the man object is the recovery or manitemance of beath, the death-rate is down to 9 per 1000, while in others, where the man object is manufacture and money-making it is as high as 20 per 1000. Nowhere, I think, in the control of the control of the control of the control than in India during the past thirty years. A Royal Commission was appointed after the Crimens was to inquie into the sanitary condition of the British Army, and this in 163 ps was extended to have the control of the control of the control of the insist troops were referred to incidentally. Here the inquiry had to deal with a large body of men, concerning whom, wheir cosditions of custices bury well know, reliable information was

accessible. It was ascertained that up to that time the annual death rate over a long period had stood at 69 per 1000. The inquiry resulted in certain changes and improvements in the housing, clothing, food, and occupation of the soldier. Since those have been carried out there has been a steady decline in the death-rate, and the annual reports of the Santtary Commissioners to the Government of India give the rates as in 1386, 15 189 per 1000; 1887, 14 20 per 1000, 1888, 14 54 per 1000

During some years it have been even lower, down to per 1000, whilst the general efficiency of the troops has increased It is not easy to estimate the money conjugatent of this. but if we take the rough standard which values each soldier a £100, a simple calculation will show how great is the gain, and who can estimate the value of lives saved and suffering avoided? As to native soldiers with whom the European troops may be compared, I find that the death rate was in 1886, 13'27 per 1000 . 1887, 11'68 per 1000 . 1888, 12 84 per 1000 cholera, and other epidemic visuations in some years disturb the regularity of the death-rate, under less favourable conditions of regularity of the death-rate, under less favourable conditions of living, as in the case of prisoners in the gools, it is somewhat higher. In the Indian gools, for example, it was in 1886, 31 85 per 1000, 1887, 34 15 per 1000, 1888, 35 57 per 1000. On the whole, all this indicates improvement, and as regards the civil population progress also is being made, but here, from the civil population progress also is being made, but here, from so many disturbing causes, the figures are neither >0 easily obtained nor so reliable. The compartively large mortality is due to neglect of the common sanitary laws added to extremes of climate, which favour the incidence and diffusion of epidemic. disease, and intensify it when it has once appeared. A Sanuary Department has existed in India since 1866, and every effort is made by Government, at no small cost, to give effect to sanitary laws, there can be little down that the results, so far, are good, that disease generally is diminishing, and that life is of longer duration. An important result of the observations of the able medical officers of the Sanitary Service of India has been to show that cholera is to be prevented or diminished by sanitary proceedings alone, and that all correive measures of quarantine or forcible solution are futile and hurtful. Here I may ay that, large as may appear the death rate from cholera in India (i e in 1888, 1 99 per 1000 for the European army and 1 35 for the civil population), it is small compared with that of fevers, which caused in 1889 4 48 per 1000 in the European army and 17 09 in the civil population, but there is every reason to believe that these also are becoming less fatal under the influence of sanitary measures. In preventive as in curative medicine, knowledge of causation is essential It is obvious that any rational system of proceeding must have this for its ham. A certain empirical knowledge may he useful as a guide, but no real advance can be expected with-out the exactitude which results from careful scientific observation and induction, the spirit of experimental re-earch, however, is now dominant, and progress is inevitable. How much we owe to it is already well known, whilst under its guidance the reproach of uncertainty which attaches to medicine as a science is dis or uncertainty which attaches to mentine as a science is dis-oppearing. Recent advances in physiology, chemistry, histology, and pharmacology, have done much to throw light on the nature and causes of, and also on the means of preventing or of dealing with, disease It is impossible to exaggerate the value of the scientific researches which have led to antiseptic methods of preventing the morbific action of micro organic life, whether the toxic effects produced by them, or those induced autogenetically in the individual Theory has here been closely followed by its practical application in prevention and treatment of disease, whilst the study of bacteriology, which is of such remarkable which may flow results of incalculable importance in their bearing on life and health That the conclusions arrived at are which may flow results of incalculable importance in their bearing on life and health. That the conclusups arrived at are always to be depended on I doubt, and it seems that scientific scal may perhaps sometimes outrun discretion. That it might lewiser to postpone generalization has, I think, been more than once apparent, whilst the expediency of further investigation before arriving at conclusions which may subsequently prove to be erroneous should not be lost sight of; but it has probably

"I'll va be bestored with regrets that during the last five years there have a studied by the last five years the relative to the studies of the last five years of the last whose this will grow only transviors, the statestors of santiary are moral of whateve may be the cause of it. I'm shown both by the vital moral of whateve may be the cause of it. I'm shown both by the vital energous assumpt of preventable where and death, but "I this the local manifelty profilions or local flucase causes are well known and wadeyveau."

— S. C. Nappen for 1896.

ever been so in the course of scientific progress, that in the enthusiasm of research, which is rewarded by such brilliant results, early generalization has too often been followed by disappointment, and it may be by temporary discouragement of

hopes which seemed so promising.

It would be well to bear in mind a caution recently given by
the Duke of Argyll, "that we should be awake to the retarding effect of a supersitious dependence on the authority of great men, and to the constant liability of even the greatest observers med, and to the constant manning of even use greatest observers to found fallacious generalizations on a few selected facts: (Nindeanth Cantury, April 1891) Still, it is in the region of scientific research by experiment that we look for real progress, and we can only deplore the mataken sentiment, the laise estimate, and the misconstruction of its sapirations and purposes, which have placed an embargo on experiment on living animals. watch naw places at entourpoon experiment on invine animans, rendering the pursuit of knowledge in this direction well much impossible, if not criminal; whilst for any other purpose, whether of food, clothing, ornament, or sport, a thousandfold the pain may be inflicted without question. The inconsistency of the sentiment which finds unwarrantable vullering in an operation of the proposition of the propositio performed on a rabbit, when the object is to preserve human or animal life or prevent suffering, but which raises no objection to the same animal being slowly tortured to death in a trap, or hunted or worried by a dog, needs no comment, whilst the spirit which withholds from the man of science what it readily concedes to the hunter is, to say the least, as much to be

It must be remembered that, important as are the researches into microbiology, there are other factors to reckon with before into microtology, there are other factors to reckon with before we can hope to gain a knowledge of the ultimate causation of disease. It is not by any one path, however closely or carefully it may be followed, that we shall arrive at a full comprehension it may be followed, that we shall arrive at a full comprehension of all that is concerned in it, etiology and prevention, for there are many conditions, dynamical and material, around and with us which have to be considered in their mutual relations and bearings before we can hope to do so, still, I believe we made that the cause of disease are now being more thoroughly sought out than they ever have been-all honour to those who are prosecuting the research so vigorously—and that though individual predilection may seem sometimes to dwell too exclusively on specific objects, yet the tendency is to investigate everything that bears upon the subject, and to emphasize all that is implied in the aphorism, Salus populi, suprema lex

The morning sitting of the Section and most of the afternoon sitting was devoted to papers and a discussion on "The Mode of preventing the Spread of Epidemic Disease from one Country to another."

another."
The chair was occupied successively by the President, Professor Brouardel of Fairs, and Prof. da Silva Amado of Lisbon Surgean-General Cuningham, of London, epened the discussion, and said the nodes of presention of spread of disease. from one country to another were three in number, (1) quaran-tine, (2) medical inspection, (3) sanitary improvements. In his remarks he dealt chiefly with cholera, and he held that the chief remarks as cent clienty with contern, and ne neit that the client factor of choleta, being carried by atmospheric currents, cannot be excluded from any country, and where it has been distributed over any area it excites the disease directly in many persons who are predisposed to it, and forms foci of it whenever it finds localities suitable for its increase, these are often very limited in extent, not embracing more than a single house, or even a portion of a house, or sbip, the mortality among the steerage passengers in the latter is often very great, the steerage passengers in the latter is often very great, while the cabin passengers and all the crew have scarcely a case. Such foot are always badly ventilated, and the emanations arising in them acquire much greater density than in the open air, as a natural consequence the clothing of those who reside in them about a momont of the emanation sufficient to produce cholera in susceptible persons outside until it has been dissipated by exposure, those so affected, however, and the other, who have contracted the complaint spart from such foci, do not seem to have any such influence, it being not the body but the emanations from the locality which generate the disease Cholers, therefore, cannot be excluded from any country by general quarantine. All that can be done is by hygienic measures to improve the health of the population, and to remove the conditions which favour the formation of foci The placing ships which arrive with cholera on hoard under observation, removing their crews and passen-gers to suitable localities on shore until the disease ceases among

them, are very proper precautions, and may prevent a small amount of the disease among the surrounding population, but can never prevent an epidemic if the necessary factors be in

Chin never present the progress Inspector General Lawson then followed with a paper on "The Communicability of Cholera from one Country to

To draw up a plan to prevent the extension of a disease, say cholera, from one country to another, with any prospect of success, it is necessary to have a general acquaintance at least with the different factors which contribute to the result, and of with the different factors which continue to the result, and of their mode of operation. The existing information on these points falls far short of these requirements, and its increase ha-been enormously impeded by the belief that man himself is the chief agent in diffusing the disease, and by interpreting the evidence obtained from various sources with an undue bias in favour of the theory There has been, in short, and still remains, a most serious error in assuming that personal communication is the principal factor, and a no less extensive error in the methods and reasoning by which the central idea of diffusion by man was advocated

The character and causes of cholera must be derived from a critical examination of all the evidence Nature presents, and from a study of the methods she hersell adopts, instead of from our a sutoy or me methods sile hersell adopts, instead of from our a press deduction. Cholera occurs in two different forms: simple cholera or cholera nostras, of little everetry, and attributed to local cases, and Assite epidemic, or malignant cholera, always a serious disease, and by many attributed to a possogreen of by those latouring under it to others, and so diffused

until it becomes epidemic.

Since 1832, when cholera visited Europe in the epidemic form, cholera nostrus has been observed to fluctuate every few years, and with the milder cases occur a certain number present-ing all the characters of the malignant disease, these cases occur singly or in small groups, but in every histance they accompany

pidemics of varying severity, at no very great distance off, and re under the same "epidemic influence"

Those who support the theory that man diffuses cholera are, necessarily, required to show that persons under the disease must arrive at points where it has not yet appeared, before it commences in these latter, and that the first attacks in the new locality have been in persons exposed to the imported eases: but there are now a good many instances of epidemics springing up in localities at a distance from where the disease was already prevailing, and without any trace of importation, and where those first attacked had resided in the country for many months in succession without communication with any previous case Such were the outbresks at Southampton in 1865, at New Orleans in 1873, and at Foulon and the south of France in 1884, all of which were most carefully investigated on the spot. The only other conclusion open was that the necessary factors were supplied by epidemic influence, and if supplied in one instance, supplied in all where there appeared to have been importation at the commencement of the outbreak, it must not be assumed that the disease was communicated by man unless the epidemic influence could be excluded, as at present it could not. It seemed probable that the exciting factors were conveyed by the air, whether fully or only partially developed, and consequently it was not in our power to exclude them; but much might be done by hygienic and other local means to limit their development in the localities they reached, and so to avoid

accessive moriality Thompson, official delegate of the Government of New South Wales, followed with a paper entitled "Quarantime in Australasia. Theory and Fractice." He said that the amount of traffic which had to be dealt with was an that the smooth of traine which had to be dealt with was as important consideration in all questions of practical quarantine. The Australasian Sanitary Conference of Sydney, N.S.W., 1858, was attended by delegates of each of the six Coverments, and by the speaker Their resolutions were unanimous, accepted by each Government, and pre-nieted to each Parliament. They had not been modified since 1854, and were therefore those received in Australasia at the present day. Limited quarantine tine, medical inspection, the outcome of England's local condi-tions, was exactly suited to them, but not necessarily suitable, therefore, where local conditions differed from England's. The theretore, where local conditions americal from England's. Lee first proposition of the Conference was that the deprive of protection which guarantine measures can afford varies inversely with the ease of communication between the sufected country and the country to be defended. The difference between English and Australisain conditions was described. The Conference rejected accined quaranties as a principle of action, and on account of easy and daily interchange of population between the use of a conference of a co

Dr. Rochard, of Faru (whose communication was read by Dr. Julea Bergron), said that the measo of preventing the traismission of spilemic diveases, such as the plaque, yellow fever, and hochera, were threfold—namely, robation, disinfection—and and the place of the place of the place of the place of the traismission of the place of the place of the place of the place It was also the most difficult to the place of the place of the place intervention of public enactioners, and the existence of an entact intervention of public enactioners, and the existence of an entact intervention of public enactioners, and the existence of an entact intervention of public enactioners, and the existence of an entact intervention of the second of the place of the place of the place tensity of the development of contemporary science. The high that when we had santary towns we could brave epidemics England had spent five millions wance the commencement of the entury, and it do not fear choicer danging the fast evidence. England had spent five millions wance the commencement of the entury, and it do not fear choicer danging the fast evidence. England had spent five millions wance the commencement of the entury, and it do not fear choicer danging the fast evidence England had spent five millions wance the commencement of the proceeded to detail the means taken as the fronter by the French anthorities during the last choicer applicance in Spain, and employment of liber nearests which responded to the meany taken future developed some better remedy.

In Sickonia, of Constantionities are mentioning the methodquarantine and impection, detailed by previous speakers, and that Turkey was like numerous other countries, one in which anitary organization had yet to be curried out. If Cholera has entered. Turkey in these last years by Busjonch (Persan Gulf) accord with the progress of sanitary science. The plignings of the Musualmans to Mecca, is also a great source of danger to the country. The laracted of Turkey ought to be made sanitary,

conditions are districtly output to be made animary. Dr. Hewitt, of Munestota, U.S. A, said they had very little to do in his State with disease properly called epidemic except that of small-pox. Choicer had but not one obtained something of a lodgment, and then it came directly from the port of New York ports of Egipand, and most of it came through the Culf of St Lawrence. Only the other day cases came from Liveppool to Mineseita. He mentioned one case in which inferion was carried in the dollaring of a form a highest on the refused in the College of the

demand was that there should be complete sanitary central organnation, with local organization in direct (calcium thereto, and parameters are considered to the constraint of the conquarantine service, which should be bound to give notice to the interior authorities of the presence of disease. On Infection, and that they should all on course for its contract or infection,

Dr Simpson, of Calcutta, stated that the real source of cholera epidemics in Europe was, in his opinion, from emigrants and pigrams coming over land and in ships to Mecca, where there was a focus 2000 miles nearer Europe than any Indian port. Dr Leduc, of Nantes, agreed with Dr Cunnigham as to the

Dr. Ledwe, of Nantes, agreed with Dr. Chinngham as to the need of improved santary contitions in our forms, but he strongly disagreed with him when he proposed the suppression of quarantine. Modern science teaches us that contagous discases are spread by wandering germs isolation must therefore he a preventive to the spread to the disease, and quarantine the suppression of quarantine was to propose a measure at one that the proposed of the proposed of the proposed of the restriction of the proposed of the proposed of the proposed previously district the proposed of the proposed of the proposed previously district the proposed of the proposed of

Dr. Thorne Thorne, of I ondon, spoke of the need of sanitary reform in towns, and depretated the so called protection of a country by means of cordons, quarantine, &c. The sixteen days' quarantine decided at Constantinople in 1866 failed, the ten days' quarantine decided at Vienna failed, and yet the five days' suggested at Rome is to succeed. The contention is altogether illogical.

Frot. Stelvers, of Amsterdam, said that at the International Medical Congress at Ansterdam there was a discussion on quaranties, in which the same arguments for and against wer and the same arguments for and against were supported to the same arguments for any supported to the same arguments for any supported to the support of predemic discusses, and especially of cholera, was to make sanitary improvements. If the had arrived at this conclusion by the study state have improved the same arguments of the same arguments and the same arguments and the same arguments are the same arguments and the same arguments are supported to the same arguments and the same arguments are supported to the same are supported to the same arguments are same arguments are supported to the same argum

instorical carriosity

misconical carriosity

The following sellemen also took part in the discussion

The following sellemen also took part in the discussion

The following sellemen sellement following sellement

Following sellement following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Following sellement

Follow

In the afternoon, hir John Banks, K.C.B., in the chalt, Dr. Manson read an elaborate paper on "The Geographical Distribution, Pathological Relations, and Life-history of Fibrara sanguins hominis there and Filters sanguins hominis from the first sanguins hominis provints in connection with Preventive Medicine." The paper was illustrated by numerous unicroscopical specimens.

Dr. Manson said that the discovery of the blood-worms herein

Dr Manson said that the discovery of the blood-worms herein named Fidara sunguants homms district and Fidara sunguants homms there are assignants homes from the probable publicing and interpretable their possible publicing and the probable publicing and the probable publicing and the probable the view to intervention in respect to them of preventive medicine. The facts that these parasites and the disease known as negro

and traces must intere parasites and the one-me shows a negrolethingy, or sleeping sackness of the Congo, are endemic in the same region, the West Coast of Africa, that neither can be sequired unless in this particular region, and that sleeping sackness may declare itself many years after the endemic region has been quitted, and that these filarize continue to live for many years after the negro has left Africa, suggest a possible relationship between these parasites and this disease

been quated, and that these filarue continue to live for many years after the negot has feld Arize, . urgear a possible relationship years after the negot has feld Arize, . urgear a possible relationship and the second state of the deeping and the second state of th

this the inference may be drawn that, in certain cases, at all events, of sleeping sickness a filaria embryo is present in the

Filaria s h diurna and Filaria s h. perstans have both

been found in a case of sleeping sickness. been found in a case of sleeping sickness.

These facts taken together amount to a presumptive case against
one or other of these parasites as the cause of sleeping sickness.
The probable life-interies of these worms is then indicated,
the Filarin los being considered the parental form, and an inthe Pilaria lea being considered the parental form, and an in-sect, called the mangrowe fly, the intermediary host of Pilaria is hairna. The parental form of Filaria is h fertilaria is not known, but, assuming that the worm of craw craw, skepping suckness, and dermalous parantaire is the same, and that the skin form a an advanced stage of the embryo filaria found in the skin form is an advanced stage of the emoryo mara found in the blood, then, arguing from the analogy to what happens in the case of the embryo of Filaria mediumsis, which closely resembles this skin parasite, the probable intermediary host of re-embles this skin parasite, the probable intermediary host of Filaria 1 h gerdian: as freshwater animal, possibly a cyclops, Provided the hypotheses as regards there parasites and the diseases they produce are correct, both divesse and parasites may be avoided by securing a pure water supply to which the intermediary hosts of the parasites do not get acceptable to for assistance in cleaning up the subject, and for further in for assistance in cleaning up the subject, and for further in

An appendix to the paper contains directions for demonstrating in the surest, most rapid, and most effective way the presence or absence of filaria embryos in blood, and of making collections of slides of blood for storage and future examination Dr Sonsino, of Pisa, made a few remarks on Dr Manson's sper The meeting then adjourned.

On Wednesday, August 12, the chair was occupied suc-cessively by Sir Joseph Fayrer, Dr Pistor of Berlin, and Surgeon General Roth of the Saxon Army

DISCUSSION ON DIPHTHERIA

Dr. Edward Senson, of Londou, opened a dicension on "Diphiens, with opened reference," and distribution and to the need for comprehensive and systematic inquiry into the causes of its prevalence in certain countries and parts of countries, with a view to its prevention."

Dr. Seaton and that he should confine himself in introducing

Dr. Seaton and that he should confine himself in introducing in subject to leading statements, showing the necessary for competeness and systematic inquiry to be pronoted by Govern countries and parts of comprise, with a view to its prevention. He first of all pointed to the special prevalence of the daesae, as shown by Ir. Longstaff, in Norfolks and Wales, and the foundation of the control of the daesae, are the disease prevailed more in He then dwelt on the facts that the disease prevailed more in rural than urban districts, although it has shown of late years an increasing preference for urban populations, especially that of London. He showed the independence of the disease of what are ordinarily called vanistay conditions, and illustrated that by a table taken from Dr Thorne Thorne's recent electures at the Royal College of Drystanas, showing the fall in enteric fewer mortality in Bigland and the College of Drystanas, though the con-tinuation of the College of Drystanas, though the fall in enteric fewer mortality in Bigland and the College of Drystanas, though the con-tinuation of the College of Drystanas, though the College of Drystanas, the College of Drystanas, though the College of Drystanas, the College of Drystanas, though the College of Drystanas and D mortatily in England and wates which had spinchfolized with a rate in the mortality from diphthers. He further what are usually termed sanitary conditions by experiences gathered from a large manufacturing town in the Midlands, and from certain parts of the metropolis in which he had special opportunities for observation as a medical officer of health, as well as in connection with the work of the Metropolitan Asylums well as in connection with the work of the Metropolitan Asylums Board, into whose hospitals cases of diptherins had been re-bened to the most of the most of the most of the con-experience of a Surrey village, in which the disease had pre-valled in an epidemie form, shortly after the replacement of the old insanitary cesspool system by a new and elaborately con-structed sewerge system. The occurrence of the disease under these circumstances gave rise to the suspicion that there might be a connection between diphtheria and conditions of soil, which needed to be investigated in a comprehensive and systematic manner, to be investigated in a comprenensive and systematic manner. In conclusion, he pointed out the importance of these main considerations, viz. (t) the prevalence of the disease in strakingly different degree in countries in the same latitude and with similar climatic conditions and also in parts of countries close to each other, (2) the fact that it has not apparently been influenced favourab by the adoption of sanitary measures which have been generally

found effective in reducing the death rate, prove the necessity for a comprehensive inquiry by our own Government as well as those of other countries, into the causes which determine the prevalence of diphtheris. Such an inquiry should take into those of other countries, into the causes which determine the prevalence of diphthers Such an naquity should take into account what has already been ascertained with regard to the occasional causation and spread of the disease by milk, and the influence which schools have on its production and spread, and also the subsidiary influence of deimpness, dirt, overcrowding, &c ; but its main object would be to ascertain the local ing, &c; but its main object wouls doe to ascertain the local conditions and circumstances who caccount for the growth of the disease. To ascertain these the inquiries must, of course, be made in countries murked by freedom from the disease as well as in those which suffer from it specially. Dr. Schrewen, of Tournai, followed with a paper entitled "Contribution a Fétude des cases arounant les endemles diphehériques," of which the following is an abstract

By investigating carefully how the ravages committed by diphtheria are distributed over the different districts, one can diphtheria are distributed over the different districts, one can attain more easily to a presets knowledge of the external conditions which favour the barbouring of diphtheritic germs, and which result in such germs heng frought into a locality. In-different control of the co ravages the same fact was observable in the case of diphthems; and that when ehiphthems secured its smallest number of vectors the number of deaths caused by typhool fever diministration of the control march of diphtheria and typhoid fever stands out clearly On what does this relation, this agreement rest? On this fact, that these two diseases must be considered as feecal diseases, as B. these two diseases must be considered as feecal diseases, as B. Russell, of Glasgow, has remarked The bacilli of Loffer, like the bacilli of Eberth, develop admirably, prosper, and extend wherever filth and rubbish of all kinds are stored up or spread out, there exists, however, this slight difference between the conditions which are severally favourable to them impurities on the surface of the soil suit the bacilli of Loffler in a special degree, while impurities of the subsoil please the bacilli of erth better.

Even the exception formed by East Flanders tends to confirm this rule, masmuch as it is perfectly clear that its surface ought to be more easily cleared of all impurities by reason of the to be more easily cleared of all imparities by reason of the numerous watercourses which furrow it. A further proof that it is, in a special degree, impurities of the surface which serve to harbour diphtheritic germs in certain localities, is the exaggeration of mortality from diphtheria in country distincts compared to what obtains in towns, density of the population is not of the least influence on the increase of the mortality due to diphtheria, but the surface of the soil is much better protected in towns against impurities of all kinds

Another circumstance which may foster diphthena in a locality Is the breeding of certain species of animals presenting a great receptivity for diphtherogenic germs for example, Italian fowls and game-cocks. The transmission of diphtheria to man by these animals is so well established by the observations colthe the salimans is so were examined by the observations con-lected by the author for several years past that he feels per-suaded of the need of further attention being paid to this subject. Finally, a third condition which necessarily fosters diph-theria in a locality is the aegligence exercised in the application of measures of disinfection and holdation.

Every case of diphtheria must be notified to the local anthority, who will see to it immediately that all the children anthority, who will see to it immediately that an the cinieren of the sick periods family be kept away from school as long as any danger of contegion exists. In every case distribution must be ragorously attended to and performed by special agents. Notification and disinfection ought to be obligatory. The altitude of the locality does not probably exercise any very great influence. One would suppose that diphtheris would be specially prevaient in low, damp pixees. Recent observations are considered to the content of the content of the speciality prevaient in low, damp pixees. Recent to be specially prevaient in low, damp pixees.

very great influence. One would suppose that depintheria would be specially prevalent in low, damp places Recent observations by the author on the progress of diphtheria in three contiguous parishes of the district of Ath (Eadeghien, Ostiches, and Mainvault), show that in each of these parishes there was a

principal seat of the malady, and that in the three parabes this seat was in precisely the most elevated hamlet of ill, a fact which from the first appears somewhat strange. One may, perhaps, conclude that Loffler's bacillus does not like too much damp, and that it is in this respect that its character differs from the bacillus of Eberth

Dr. Hewitt, Secretary and Executive Officer of the State Board of Health of Minnesota, U.S.A., said that his experience covered eighteen years of saultary service with the disease in an interior State of the American Union with a very complete public health service, consisting of 1575 local hoards of health, with a State Board Notification of infectious disease by physicians, householders, hotel and inn keepers, has been obli gatory since 1883 with penalty, as is also isolation and dis-infection by the local boards of health. The facts believed to he proven in Minnesota were that the disease is very infectious, that it is communicable by persons and things, that the infectemperature, that it is very tenacious of life as against measures of disinfection, and lives for long periods in clothing and bedding and on floors and walls. Isolation and systematic disinfection. and on noors and wans. I solution and systemace distinctions with the most perfect sanitary regulation, are most efficient at present in the control of the disease. Since these had been in efficient use the prevalence had assumed a family character, limiting itself to one or more associated families, and rarely hinting stieff to one or more associated families, and rarely going beyond, except by erasion of the law on the part of an infected person. What was needed now was more careful facts of each outbrack with a very to a more accurate knowledge of the disease, not neglecting the perenties and controlling measures now found to be most theness, as above. Dr. Jules Bergeron, of Parss, followed with a paper entitled with the measures plate that Dr. Jules Bergeron and the state of the person said what the measures plate that Dr. Jules Bergeron said what the measures plate that Dr. Jules Bergeron said what the measures plate that Dr. Jules Bergeron said what the measures plate that Dr. Jules Bergeron said what the measures plate that Dr. Jules Bergeron said what the measures plate that Dr. Jules Bergeron said what the measures plate that Dr. Jules Bergeron said which we have the proposed to the proposed to

that the measures to be taken against diphtheria were disinfec-tion and isolation disinfection of all clothing, &c, contamition and solution disinfection of all clothing, &c, contaminated with secretions from the affected pair, isolation of all cases and of all doubtful cases, such as those of a herpetic character, which are difficult to distinguish from diphiheran in the early stage of the disease. An important question to be answered is, How long ought isolation to continue, how long, in fact, does contagion last? Dr. Bergeron says that he adopts so weeks' isolation as the maximum, and that he has never observed a case of transmission of the disease when a case has been isolated

for this period.

Dr Gibert, of Havre, spoke of diphtheria in Havre Dr. Gibert, of Havre, spoke of diphthera in Havre Hot and that diphthera appeared in Havre shout 1866, it there was an innited to the Graville Justicer in 1866, there was an innited to the Graville Justicer in 1866, there was an innited to the Graville Justicer in 1866, there was an innited to the Justicer in 1866, there was an innited to the Justicer in 1866, there was an innited to the Justicer in 1866, the Justicer in 1866, the was a fine death content of the disease increased until 1885, when a singuist de sinishrild was formed as an annexe to the Bureau distingtion of 1867, the divellings occupied by diphtheric patients d'Hygiène The dwellings occupied by diphtheritic patients having been regularly disinfected, the mortality curve has since decreased to such an extent as to justify the hope of its total extinction, provided all the medical men of the town furnish accurate information to the Bureau d'Hygiene

Dr. S. W Abbott, of Boston, U.S.A., read a paper on "Diphtheria in Massachusetts from 1871-88." From his observations he concludes that diphtheria is an eminently contagious disease, that it is infectious, not only by direct exposure of the sick to the well, but also through indirect media, such as clothing and other articles that have come in contact with the sick; ing any other actions may be some as in the case of some of the other infectious diseases, notahly small-pox and scarlet fever. Dr Abbott also concludes that overcrowding, &c., favours the spread Abbott also concauses that overcrowing, &c., favours the spread of the disease, but that its transmission through the water supply is not proved. Its transmission is favoured by soil-mosture and dump houses, and the poison may remain infective to hosses for a long period.

If the district of the distr

the Morement of the Subsoil Water." The conclusions he arrived at were that the organism of diphthers inshins organi-ally polluted surface-soil, and that, subject to suitable conditions and the subsection of the subsection of the subsection of the food, it threes and multiples in the soil, the superment, and thus produced being liable to displacement from the sitemines of the polluted surface soil, and to dispersal into the appear-nments of the polluted surface soil, and to dispersal into the superm-cambout air; in this manner detertialing outbreaks of the disease. So that, given the existence of the publique form, two sets

of factors at least are engaged in the production of a state of affairs that culminate in an outbreak of diphtheria First, those that promote and support the growth of the germ in the soil. such, for instance, as moisture, temperature, air, food, and so on Secondly, agents of dispersal, by which the germs already existing in the soil are driven out and distributed into the atmosphere, and so come to be breathed by man and animals, for example, sudden rainfall, rise of subsoil water, lowering of barometric pressure
Mr Charles E Paget, of Salford, followed with a paper on

"A Local Examination of the Difference in Susceptibility between Old and New Residents"

The general conclusion at which he arrived as the result of an The general conclusion at which ne arrived as the result of an aximation of the statistics of Salfori was, that a shorter average period of residence before an attack of diphtheria was observed where the general mortality rate was highest and once word, that, in fact, the relative incidence of diphtheria during an epidemic period, in respect of length of residence, was de-

an epidemic period, in respect of length of resucence, was de-pendent to no small extent on general santary circumstances. Prof. D'Espine, of Geneva, foll-wed in the discussion. He drew attention to the great value in the prophylaxis of diphtheria, in the systematic washing out of the mouth and pharynix by antiseptic solutions, corrosive sublimate (t in 10,000), salicylic acid (r in 2000), and line juice In his practice he used salicylic

acid (it in 2000), and linne juice
In his practice he used salicylic
acid in the strength of 1 j to 2 per 1000
Dr Tripe, of Hackney, who followed, said he had had large
experience of this disease, as he had been 35 years Medical
Officer of Health in Hackney
During that time all deaths had
been investigated, and lately all cases, with the result that there was no evidence that insanitary conditions of houses caused the disease, although they might predispose to it. He believed that closing playgrounds in schools is as effectual in checking the disease as closing the schools, that prompt removal to hospital and disinfection of clothing and rooms, burning of infected rags, &c., are the best methods for checking the disease.

Dr Thursfield, of Shrewsbury, agreed with Dr Hewitt that dampness had a great deal to do with the citology of diphtheria, he had lumself stated so thirteen years ago in a series of papers on the subject. He thought Dr. Adams's conclusion regarding the connection of the rise and fall of the subsoil water with out-

the connection of the rise and tall of the subsoli water with out-breaks of diphtheria a somewhat hasty generalization. Dr. Gunther of Dresden, Dr. Janssens of Brussels, Dr. Hubert of Louvain, Dr. Escherich of Graz, Dr. Jules Felix of Brussels, and Dr. P. Sonsino of Pisa, also took part in the discussion, many of the speakers emphasizing the need of local anticeptic measures in the prophylaxis of diphtheria.

anticeptic measures in the prophysics of dipinteria. At the end of the discussion, the following recommendation was unanimously adopted by the Section —
"That this Section urges the European Governments to make a comprehensive and systemative inquiry into the causes of diphthera."

On Tuesday afternoon, Sir John Banks, K.C.B, and

Overlacge Bentzen, Christiania, occupied the cliair, DISCUSSION OF THE PREVENTABILITY OF PHILIPSIS.

Dr Arthur Ransome, F R.S., read a paper "On the Need of Special Measures for the Prevention of Consumption." He said, that consumption is both curable and preventable will be acknowledged at once by all medical men who have had any experience of modern methods of dealing with the disease.

experience of modern methods of deathing with the disease. Its currishinty is attested (if) by the reports of many pathologists as to the presence of evidence of healed phthiss in a large proportion of bodies examined in public institutions. Many thousands of such examinations have now been made, and the unousants of such examinations have now been made, and the results show that from 25 to 50 per cent of persons dying from other diseases than phthats give signs of spontaneous cure of tubercular disease. (2) The tectimony of all the most eminent modern physicians is to the same effect, that consumption is distinctly curable

With regard to the preventability of the disease we have also a strong basis for our faith.

a strong basis for our tain.

(i) In the marvellous results that followed the improved dramage and ventilation of the harracks of the British army in all parts of the world. Before the year 1842, the mortality from lung disease amongst the picked population of these dwellings was a scandial to the nation, and was enormously greater than that of the ordinary inhabitants of our towns, especially in the battalions sent to warm climates, such as those of India, Ceylon, the West Indies, the Mediterranean, &c.

Thanks to the above mentioned measures, it now stands at

from one-third to one-tenth of its former rates.

(2) The influence of improved drainage has been shown by (a) The influence of improved dramage has been shown by T Buchanan, in his table of towns, contrasting the mortality by phishas and other diseases before and after the introduction of the general phishins rate of the country from agoo per 1,000,000 in 1867, to 1500 per 1,000,000 in 1889. My own observation in Manchester and Salford, and those of Dr. Tiven in Oldham, and of Dr. Tiven in Philadelphia, and of Dr. Tiven in Philadelphia, and of the property of

bouses. Under these circumstances it seems to me that the duty of sanitary authorities is clear. They should regard pithusis as a disease to be dealt with on precedy the same lines as the analogout diseases, typhoof fever, clotter, and feyour,—disease which spread by material throws off from the bodies of the patients. The means to be employed to thus end would also be very similar of 10 notification of cases, 2) disintalection, (3) loopital accommodation, and (4) general sanitary measures, such as ventilation, dranges, and reconstruction of unhealthy

(1) Notsheatron -At first it may sound somewhat novel to (1) Notification —At Inst it may sound someware moves to demand that a slowly progressing alment like phihus should be notified as if it were liable to become an epidemic disease, but, after all, we may fairly inquire whether the purpose of notification is not the prevention of any disease that could be arrested by early intelligence of its existence being sent to the health officer, nor would there be much difficulty in oblaming. the notification of phthisis Although phthisis is not directly contagious, there would be nothing uttreasonable in classing it with other diseases that need special measures to prevent its

(a) Distinction.—After recoving notice of a case of tubercules, the next step to be taken by a local authority would be to accratian whether proper care is or can be taken to preven the proper care is or can be taken to preven the information is given by the metical attendant would be said faceat, but where the case is that of a poor person it should be sufficiently but where the case is that of a poor person it should be sufficiently and the sufficient of the premises, and to the disposal of distinction by subplier and the steaming of dolbest should be carried out. Paper spintons that can be burnt should be instead upon After death, also, measures should be taken for the deating and dissification of house, bedding, and clothes the deating and dissification of house, bedding, and clothes question of the propriety or possibility of removing the sick (2) Disinfection .- After receiving notice of a case of tubercu-

(3) Hayifal Accommodation — Their would next come the question of the propriety or possibility of removing the sick person to hospital. So long as he for she) could work, and so remove the property of the property of the property of the more than I have aiready indicated; but when the patient becomes unable to follow his employment; and the family are obliged to acek for assistance from the parith, he has a claim to be received into the workhoose hospital, and such an anytim abould be offered him, and should be made as little humiliating and as free

from ignominy as possible
(4) But it is probably to general sanitary measures that we (4) but it is prousing to general same and mortality from tubercle

It has been found that deep and thorough drainage of the subsoil will greatly diminish this mortality. of Salisbury, as you are probably aware, it was reduced by one-half, and similar reports have come from other towns, and though the same result has not always been obtained elsewhere, there can be no doubt as to the importance both of draining and concreting the foundations of dwelling houses, so as to prevent organic vapours from rising along with the ground air

into living-rooms.

It is for this reason that I have ventured to suggest that where consumption is prevaled there must exist some special numment which either (t) serves to prolong the life of the bacillus.

retain its power for evil much longer than when it was exposed to some fresh air and light.

It is possible that these may be regarded as somewhat strong proposals, but at least they have the merit that they may all be proposals, but at least they have the ment that they may an up to flore without any material increase in the powers now possessed by local subhorities. The only thing needed to enable them to be carried out in their entirety is a powerful public opinion to back them up. When people generally, and especially the working classes, realize that a large part of their distinguishment. celly the working classes, realize that a large part of their side ness and consequent loss of time and money is due to their ness and consequent loss of time and money is due to their neglect, they will unquestionally be on our side. The under-taking possesses, moreover, the further ment that not only will all this sanitary improvement prevent consumption and other tothercular diseases. by doing away with the sources of infection, but it will also prevent them by raising the general standard of health amongs town dwellers. It will so strengthen those who are already predaposed to the disease that they will more rankly throw of any stray germs of tubercle that may find an entrance into their bodies. conduce to spontaneous care, will prevent recurrence of the Of Soil on the Spread of Tuberculous Diseases "On the Influence of Soil on the Spread of Tuberculous Diseases"

He showed on a large map of Germany that the localities where phthisis was most prevalent were those in which there was a printing was most prevaient were those in which there was a moory soil with signating and high-standing ground water, such as aome districts in the north western provinces, in the Rhenish province, in Upper Basira, and in some parts of Silesia These facts agree with the conclusions of Bowditch and Buchanan Overcrowding did not appear to have much

and Buchanan Overcrowding did not appear to have much influence on the spread of philisis.

Dr. J. Edward Squire, of London, read a paper entitled, "To what extent can Legislation assist in diminishing the Prevalence of Consumption and other Tubercular Diseases."

Dr Squire considered that the danger of infection increase In Squire considered that the danger of intection increased with the close crowding of the sick and healthy, and with def-cient ventilation, and that by sanitary improvements this danger might be obviated. There ought also to be a proper supervision of food (meat and milk) obtained from tuberculous cattle. I rade

of food (meat and mulk) channel from tuberculous cattle. I rade an relation to philms were also discussed.

Dr. Gibert, of Havre, followed with a pater entitled "De is distribution geforaphague de la Unitario phinoasite dans la description of the proposition, avec l'alcoolume, et avec la musice "Dr Gibert thought from houberrations that overcrowding was a great factor in the etiology of phihms but that a leoholism played a much greater part, and poverty was also a factor ! If showed on a map the distribution of phihms in Havre Sr John Banks, of Dahlin, who spoke in the discussion, Sr John Banks, of Dahlin, who spoke in the discussion,

mentioned that the sanitary improvements undertaken in Dublin had produced a great diminution of disease Practice both in hospital and private had demonstrated this to him. Mr Weaver, of London, and Dr B O'Connor also took

part in the diacussion.

LETTERS TO THE EDITOR

[The Editor ages not hold himself responsible for openions ex-pressed by his correspondents. Nisther can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other pair of NATURE No notice is taken of anonymous communications.]

Aërial Roots of the Mangrove

Aérial Roots of the Mangrove
IN 500 mot on a recent meeting of the Royal Botanic Society
(July 50, p. 504), it is attach that the only explanation yet offered
(July 50, p. 504), it is attach that the only explanation yet offered
the differs and preventing the said from being washed away,
Withoutin any way deracting from the ingenuity and probailing of Mr. Sowett's explanation, it can hardly be admitted
ability of Mr. Sowett's explanation, it can hardly be admitted
The preclusirities, both structural and physiological, of the main
grow-vegetation of the swamps of the Mainyan Archipelago
have been, during recent years, a special subject of investigation
by bostnika isolated at the Botanical Laboratory is Bultimong; ment wince einer (s) erres to prolong the life of the beachist
of tuberde, or (2) she him any even moreaue in virtuelit properties, this special element in food air being either the coganities, this special element in food air being either the coganities, this special element in food air being either the coganithat this in the only explanation that has night the college of the control of the
beaching the properties of the food of the properties of the college of the college of the college of the properties of the college of the coll

"Bibliotheca Botanica," illustrated by eleven fine plates, by Herr G. Karsten. Herr Karsten points out that, in addition to the obvious mechanical function of these roots, serving as a supporting organ to attach the trees more firmly to the very loose soil in which they grow—this is especially observable in Rhitsphora mangle—there is another important function performed by them, at least in a large number of the trees which formed by them, at least in a large number of the trees which make up the mangrore-regulation, though I do not recollect that Assessment in the specially mentioned. In the specialline scannined by Karsten, these aerial roots possess very large intercellular spaces, which serve to promote the interchange of gases, and he considers it unquestionable that their chief function is to and in commers it unquestionance that their caler function is to assist respiration. He therefore proposes for them the term "pneumatophores." It would be interesting to examine the structure of the trees at the Botanic Garden in this respect All mangrove-trees also contain large quantities of tannin, which is probably serviceable in pieventing folling.

August W. BENNETT.

August 1.

The Tasman Sea

I SEND you the inclosed copy of a letter from the Secretary of the Admiralty, in case you should consider the matter of sufficient interest for notice in your columns.

A. LIVERSIDGE, Permanent Hon Sec

Australasian Association for the Advancement of Science

The University, Sydney, July 4.

Admiralty, May 19, 1891 SIR,—With reference to your letter of March 17, forwarding copy of a resolution passed by the Australasian Association for the Advancement of Science at the meeting held at Christchurch, New Zealand, that the name of Tasman Sea should be given to the sea between New Zealand and the islands of the north-west the sea between New Zealand and the islands of the north-west of New Zealand on the one hand and Australia and Tasmania on the other, I am commanded by my Lords Commissioners of the Admiralty to acquaint you that the name will be inserted in Admiralty charts and other publications.

I am, Sır, Vour obedient servant.

EVAN MACGREGOR. To Prof. Liversidge, M A , F R S , The University, Sydney

Reduplication of Seasonal Growth

LAST summer I sent you a note on the occurrence of apple-blossoms and the blossoms of the mountain ash in July. Before bossoms and the consoners of the mountain and in July.

Before me now, as I write, is a simple but elegant bouquet containing a beautiful and fragrant coryinb of the latter tree in full flower, side by side with one of the ripe scarlet fruit, which the blackbirds have begun to devour

These were cut from one and the nica have beguin to devour. These were cut from one and the self-ame tree this morring at the top of my garden, while from the self-ame tree that the self-ame tree that the self-ame tree the leaves from which all the chlorophyl has disappeared, the phenomena which mark the beginning and the end of the season thus appearing side by side. These trees grows on the Upper Baghot Sinds, and I have no doubt that this reduplectuon of sonal growth is due to the later rains developing some centres of flowering energy in the plant, which had remained dormant during the spring owing to deficiency of moisture and warmth. Wellington College, Berks, August 17. A. IRVING.

Rain-gauges.

I HAVE been using the ordinary Symonds pattern rain-gauge, but find that the percentage of rain collected varies in proportion to the strength of the wind; when this is moderately strong, smoot the whole of the rain passes across the top, strating and being retained by vertical surface only.

The present method of estimating the rainful is far from state to correct or uniform, and I should like to ascertain if which correct or uniform, and I should like to ascertain if

any gauge has been made with a correctly-proportioned inverted cone, which will collect and compensate for side drive, and, if so, what are the correct proportions. It would appear that cither this, or a fannel mounted on glabals and balanced to face the wind at the correct angle, must be the only correct method to accertain the actual rainfall. The present apparatus would appear to be crude, untrustworthy, and incapable under any conditions in practice of giving results which are at all trust-THOS FLETCHER. Grappenhall House, Grappenhall, near Warrington. August 17

THE BRITISH ASSOCIATION

(FROM OUR CORRESPONDENT.) CARDIEL, Wednesday Morning

THE preparations of the Local Committee are now in an advanced state, and members of the Association are beginning to arrive in considerable numbers

A change has been made in the position of the Recep-tion Room, which is now located entirely in the Drill Hall, the Town Hall having had to be abandoned for that purpose owing to the impossibility of making adequate provision for the accommodation of the large number of guests expected The Drill Hall is a large building, and has been divided into two parts by a screen, which also serves the purpose of a notice-board. On the entiance side are the offices for various purposes, post and excursions : and at a central oval counter, all other requirements relating to tickets, reserved seats, publications, and lodgings are attended to by a numerous staff of clerks

Beyond the screen the hall has been fitted up as a drawing-room, and from this lead off smaller from the drawing-room by a passage is the gun room, from which were things has been removed, and tables laid down so as to convert it into a dining-room

The President's address will be given in the Park Hall, this evening, and for the half hour of waiting before the business commences Mr T E Avlward will give a recital upon the fine organ in that hall. It is understood that Lord Bute, as Mayor of Cardiff, will at the outset welcome the Association in the name of the town of Cardiff.

The conversazioni will also be given in the same hall, and from 8.30 to 9 pm, Lord Buie, as Chairman nail, and from 3,0 to 9 pm, Lord Dile, as Chairman of the Local Committee, accompanied by Lady Bute, will receive the guests At 930 pm an exhibition of views will be given by the lime-light, amongst them some fine ones, by Mr M Stirrup, of the limestone region of fine ones, by Mr M Surrup, of the Immesione region of Languedoc. Amongst other attractions will be taking impressions of finger-tips, by Sergeant Randall (Mr. F. Astronomer-Royal of Scodinal, dawings in black and white of the Himalayas, by Col Tanner; a collection of local maps and adlates, by Mr O H. Jones; the Esteddfold concert given at Swansea transmitted by the Charles of t of interest.

Arrangements have been made for military and vocal

No alteration has been made in the Section rooms from that mentioned in our former article

The publications of the Local Committee are ready for distribution, and comprise the local hand-book of 240 pages dealing with the archeology of the land of Morgan, the education, botany, geology, industries, and topo-graphy of Cardiff; the excursions-guide containing a map of the district on a scale of four miles to the inch, and two maps on a larger scale, one of the Bute Docks, and the other of the Barry Dock The excursions number twenty in all—twelve are arranged for Saturday, the 22nd, and eight for Thursday, the 27th, and moderately detailed descriptions of each are given in the guide to the excursions.

The local programme, and the list of lodgings and hotels, are the remaining publications of the Committee. The total number of members of all classes who have taken out tickets for the meeting was, at 6 p.m. yesterday,

The President's address is as follows '-

INAUGURAL ADDRESS BY WILLIAM HUGGINS, ESQ., D.C.L. (OXON.), LL.D. (CANTAB., EDIN., ET DUBL.), PH.D. (LUGD BAT.), F R S, F R.A.S., HON F R S.E., &c., CORRESPONDANT DE L'INSTITUT DE FRANCE, PRESIDENT.

It is now many years since this Association has done hos to the science of Astronomy in the selection of its President. Since Sir George Airy occupied the chair in 1851, and the late Lord Wrottesley nine years later, in 1860, other aciences have been represented by the distinguished men who have

have been represented by the distinguished men who have presided over your meetings. The very remarkable discovernes in our knowledge of the heavens which have taken place during this period of thiny branches of science—have not passed unnoticed in the addresser of your successer Persidents, still it seems to me fitting that I should speak to you to-might chiefly of those newer methods of attributional presents which have led to those discovernes, and which have become possible by the introduction since 1850 into the observatory of the spectroscope and the modern plotagraphic plate

plate
In 1866 I had the honour of bringing before this Association,
at one of the evening lectures, an account of the first fruits of
the novel and unexpected advances in our knowledge of the
celestial bodies who followed rapidly upon Kirchhoff's original
work on the solar spectrum and the interpretation of its lines.

Since that time a great harvest has been gathered in the same field by many reapers. Spectroscoper astronomy has become a distinct and asknowledged branch of the sciences, possessing a large interature of its own and observatories specially devoted to it. The more recent discovery of the gelatine dry plate has given a further great impetus to this modern side of astronomy, and has opened a pathway into the unknown of which even an enthusiast thirty years ago would scarcely have dared to dream.

In no science, perhaps, does the sober statement of the results which have been achieved appeal so strongly to the imagination, which have been entieved appear so strongly to the imagination, and make so evident the almost boundless powers of the mind of man. By means of its light alone to analyze the chemical nature of a far distant body, to be able to reason about its present state in relation to the past and future, to measure within an English mile or less per second the otherwise invisible within an English mile or less per second the otherwise invivible motion which it may have towards or from us, to do more, to make even that which is darkness to our eyes light, and from vibrations which our organs of sight are powerless to perceive to evolve a revelation in which we see unirrored some of the to evolve a revelation in which we see mirrored some of the stages through which the stars may pay in their slow evolutional progress—surely the record of such achievements, however poor the form of words in which they may be described, is worthy to be regarded as the scientific epic of the present century.

I do not purpose to attempt a survey of the progress of spec-troscopic astronomy from its birth at Heidelberg in 1859, but to point out what we do know at present, as distinguished from what we do not know, of a few only of its more important prob-lems, giving a prominent place, in accordance with the traditions of this chair, to the work of the last year or two.

In the spectroscope itself advances have been made by Lord Rayleigh by his discussion of the theory of the instrument, and by Prof. Rowland in the construction of concave gratings.

Lord Rayleigh has shown that there is not the necessary con-nection, sometimes supposed, between dispersion and resolving power, as besides the prism or grating other details of construction and of adjustment of a spectroscope must be taken into

The resolving power of the prismatic spectroscope is propor-tional to the length of path in the dispersive medium. For the heavy flint glass used in Lord Rayleigh's experiments, the thickess necessary to resolve the sodium lines, came out 1'02 cm. If this be taken as a unit, the resolving power of a prism of similar glass will be in the neighbourhood of the sodium lines. similar giass will be in the neighbourhood of the sodium lines equal to the number of cenimieres of its thickness. In other parts of the spectrum the resolving power will vary inversely as the third power of the wavelength, so that it will be eight times as great in the volet as in the red. The resolving power of a spectroscope is therefore proportional to the total thickness of the dispersive material in use, irrespective of the number, the of the dispersive materias in use, irrespective or tire number, sine angles, or the setting of the separate prisms into which, for the sake of convenience, it was be distributed. The resolving power as a grating depends upon the total number of lines on its surface, and the order of spectrum in

use; about 1000 lines being necessary to resolve the sodium lines in the first spectrum.

As it is often of importance in the record of observations to

As it is often on importance in the record or observations to state the efficiency of the spectroscope with which they were made, Prof Schuster has proposed the use of a unit of purity as well as of resoluting power, for the full resolving power of a spectroscope is realized in practice only when a sufficiently harrow all it is used. The unit of purity also is to stand for the separa-tion of two lines differing by one-thousandh of their own wavelength , about the separation of the sodium pair at D.

A further limitation may come in from the physiological fact that, as Lord Rayleigh has pointed out, the eye, when its full aperture is used, is not a perfect justrument. If we wish to realize the full resolving power of a spectroscope, therefore, the emergent beam must not be larger than about one-third of the

opening of the pupil

Up to the present time the standard of reference for nearly all op to the present time the samulation reversible to meany an spectroscopic work continues to be Angastróma map of the solar spectrum, and his scale based upon his original determinations of absolute wave-length. It is well known, as was pointed out by Thalen in his work on the spectrum of iron, in 1884, that Angstrom's figures are slightly too small, in consequence of an error existing in a standard metre used by him. The corrections for this have been introduced into the tables of the wave-lengths this Association from 1885 to 1887. Last year the Committee added a table of corrections to Rowland's scale

The inconvenience cansed by a change of standard scale is, for a time at least, considerable, but there is little doubt that in the near future Rowland's photographic map of the solar spectrum, and his scale based on the determinations of absolute wave length by Pierce and Bell, or the Potsdam scale based on original determinations by Muller and Kempf, which differs

very slightly from it, will come to be exclusively adopted
The great accuracy of Rowland's photographic map is due

The great accuracy of Rowland's photographic map is due therefly to the introduction by him of concave graining, and of a method for their use by which the problem of the determination of relative wave length as sumplified to measures of coin. The concave graining and its peculiar mounting, in which he lenses or telescope are needed, and in which all the spectra are infects together, formed a new departure of great importance in the measurement of spectral intens. The valuable method of photographic enusiren for different parts of the spectrum has canalled Froft Rowland to include m his map the whole vanible solar spectrum, as well as the ultra-violet portion as far as it can get through our atmosphere. Some recent photographs of the solar spectrum, which include A, by Mr George Higgs, are of great technical beauty

During the past year the results of three independent researches have appeared, in which the special object of the obsearches have appeared, in which the special object on the ob-servers has been to distinguish the lines which are due to our atmosphere from those which are truly solar—the maps of M Thollon, which, owing to his lamented death just before their final completion, have assumed the character of a memoral of

him, maps by Dr Becker, and sets of photographs of a high and a low sun by Mr. McClean.

At the meeting of this Association in Bath, M. Janssen gave an account of his own researches on the terrestrial lines of the solar spectrum which owe their origin to the oxygen of our atmosphere He discovered the remarkable fact that, while one atmosphere He discovered the remarkable fact that, while one class of bands varies as the dentity of the gas, other diffuse bands vary as the square of the density. These observations are in accordance with the work of Egoorf and of Ussewist, and of Liveng and Dewar on condensed oxygen. In some recent repersents Observable, with a layer of liquid oxygen concludent with Franshofer's A; a remarkable instance of the measurement of the proportion through a remarkable instance of the measurement of shootton through a remarkable instance of the persistence of absorption through a great range of temperature. The light which passed through the liquid oxygen had a light blue colour resembling that of the sky.

Of not less interest are the experiments of Knut Augstrom, which show that the carbonic acid and aqueous vapour of the

atmosphere reveal their presence by dark bands in the invisible infra-red region, at the positions of bands of emission of these

It is now some thirty years since the spectroscope gave us for the first time certain knowledge of the nature of the heavenly bodies, and revealed the fundamental fact that terrestrial matter

ia not peculiar to the solar system, but is common to all the stars which are visible to us.

which are visible to us.

In the case of a sar arch as Capella, which has a spectrum
almost identical with that of the sun, we feel justified in concluding that the matter of which is is beaut up is sumilar, and
that its temperature is also high, and not very different from the
becomes, however, one of very great difficulty when we have to
do with spectra differing from the solar type. We are thrown
hack upon the laboratory for the information necessary to enable
us to interpret the indications of the spectroscope as to the
chemical nature, but dentally and pressure, and the temperature of the celestial masses.

What the spectroscope immediately reveals to us are the waves which were set up in the other filling all interstellar space, years or hundreds of years ago, by the motions of the molecules of the celestial substances. As a rule, it is only when a body is gaseous and sufficiently bot that the motions within its molecules can produce bright lines and a corresponding shorption. The spectra of the heavenly bodies are, molecul, to a great extent absorption appears, but we have usually to study them through the corresponding emission spectra of hother brought of the corresponding emission spectra of hother brought of all selections of all selections are considered as the contraction of all selections are considered as the contraction of all selections are considered as the contraction of the corresponding contractions are considered as the contraction of all selections are considered as the contraction of the corresponding contractions are considered as the contraction of the contract years or hundreds of years ago, by the motions of the molecules mto the gaseous form and rendered luminous by means of names or of electric discharges. In both cases, unfortunately, as has been shown recently by Profs. Livening and Dewar, Wullner, E. Wiedemann, and others, there appears to be no certain direct relation between the luminous radiation as shown in the spectroscope and the temperature of the flame, or of the gaseous scope and the temperature of the flame, or of the gaseous contents of the weature table—that is, in the usual sense of the term as applied to the mean motion of all the molecules. In the content of the content of the content is the content to the charge is taking place may be low, as shown by a thermometer, quite apart from the consideration of the extreme smallness of the mass of gas, but the vibrations of the luminous inolecules must be violent in whatever way we suppose them to be set up by the discharge, if we take Schuster's view that comparatively few molecules are carrying the discharge, and that it is to the fierce encounters of these alone that the luminosity is due, then if all the molecules had similar motions, the temperature of the gas would be very high.

gas would be very night.

So in flames where chemical changes are in progress, the vibratory motions of the molecules which are luminous may be, in connection with the energy set free in these changes, very different from those corresponding to the mean temperature of the flame.

Under the ordinary conditions of terrestrial experiments, erefore, the temperature or the mean we were of the molecules may have no direct relation to the total radiation, which, on the other hand, is the sum of the radiation due to each luminous

molecule These phenomena have recently heen discussed by Ebert from

the standpoint of the electro-magnetic theory of light
Very great caution is therefore called for when we attempt to reason by the aid of laboratory experiments to the temperature eavenly bodies from their radiation, especially on the reasonable assumption that in them the luminosity is not ordinarily associated with chemical changes or with electrical dis-charges, but is due to a simple glowing from the ultimate con version into molecular motion of the gravitational energy of shrinkage.

shrinkage.

In a recent paper Stas maintains that electric spectra are to be regarded as distinct from flame spectra, and from researches of his own, that the pairs of lines of the sodium spectrum other than D are produced only by disruptive electric distinctions. tram other than D are produced only by disruptive electric dis-charges. As these pairs of lines are found revensed in the solar spectrum, he concludes that the sun's radiation is due mainly to electric discharges. But Wolf and Diacon, and later, Watts, observed the other pairs of lines of the sodium spectrum when the vapour was raised above the ordinary temperature of the Bunsen fisme. Recently, Liveling and Dewar saw easily, be source, name necessity. Avering and Dewar saw easily, be sided D, the citron and green pairs, and sometimes the blue pair and the orange pair, when hydrogen charged with sodium vapour was burning at different pressures in oxyge... In the case of sodium vapour, therefore, and presumably in all other vapour, and gases, at it is a matter of indifference whether the necessary

vibratory motion of the molecules is produced by electric dis-charges or by flames. The presence of lines in the solar spec-rum which we can only produce electrically, is an indication, however, as Stas points out, of the high temperature of the

We must not forget that the light from the heavenly bodies may consist of the combined radiations of different layers of gas at different temperatures, and possibly be further complicated to an unknown extent by the absorption of cooler portions of gas

Not less caution is needed if we endeavour to argue from the Not less castion is needed if we endeavour to argue from the condening of insen and the coming in of a continuous spectrum as no the relative presser of the gas in the coleculal atmospheres, the widening of the lines in a Plucker's tible follows upon in-creasing the density of the residue of hydrogen in the tube, when the whatening ser more frequently disturbed by fresh encounters, and that a broadening of the softium lines in a finne at ordinary pressure as produced by an increase of the quantity of softium in the flame, but it is doubtful if pressure, as distinguished from quantity, does produce an increase of the breadth of the lines. An individual molecule of sodium will be tensibly in the same Ån Individual molecule of sedium will be tenshly in the same condition, considering the relatively enforment number of the copiously fed with the volume sair. With a small quantity of sodium wapour the intensity will be feetle except near the maximum of the lines; which, however, the quantity is increased, allow the light from the sidditional molecules met with in the path of the vasual ray to strengthen the reduction of the mole-cules farther back, and so mercease the breadth of the lines

In a gaseous mixture it is found, as a rule, that at the same ressure or temperature, as the encounters with similar molecules become fewer, the spectral lines will be affected as if the body were observed under conditions of reduced quantity or tem-

In their recent investigation of the spectroscopic behaviour of flames under various pressures up to forty atmospheres, Profs Live-ing and Dewar have come to the conclusion that, though the prominent feature of the light emitted by flames at high press appears to be a strong continuous spectrum, there is not the slightest indication that this continuous spectrum is produced by On the contrary, photometric observations of the brightness of On the contrary, photometric observations of the brightness of the continuous spectrum, as the pressure is varied, show that it is mainly produced by the mutual action of the molecules of a gas. Experiments on the sodium spectrum were carried up to a pressure of forty atmospheres without producing any definite effect on the world of the lines which could be ascribed to the pressure. In a similar way the lines of the spectrum of water showed no signs of expansion up to twelve atmospheres ; though more intense than at ordinary pressure, they remained marrow and clearly defined

It follows, therefore, that a continuous spectrum cannot be considered, when taken alone, as a sure indication of matter in the liquid or the solid state. Not only, as in the experiments the injust or the soils state wood only, as in the experiments already mentioned, such a spectrum may be due to gas when under pressure, but, as Maxwell pointed out, if the thickness of a medium, such as sodium vapour, which radiates and absorbs different kinds of light, be very great, and the temperature ligh, the light emitted will be of exactly the same composition as that tions which are feehly emitted will be also feehly absorbed, and can reach the surface from immense depths. Schuster has shown

can rach the surface from mmense depths. Schuster has shown that oxyges, even in a partially exhausted tube, can give a con-tinuous spectrum when excited by a feeble electric duchauge, trum; but, on the subtrainty leaves a spectrum does not neces-sarily above the presence of compounds—that it, of molecules to the subtrainty of the subtrainty leaves that support on the containing different kinds of atoma-but simply of a more com-plex molecule, which may be made up of similar atoms, and the case—for examine, in the diffuse bands of the absoration seentherefore, an allotropic condution of the same body. In some cases—for example, in the diffuse bands of the absorption spec-trum of oxygen—the hands may have an intensity proportional to the square of the density of the proportional to the square of the density of the part of the square of the case of pressure, or it may be to the constraint to which the one-localist are subject during their encounter with one another. It may be thought that at least in the coincidences of highly lines we are not the solid ground of certainty, since the broght of

the waves set up in the ether by a molecule, say of hydrogen, is the most fixed and absolutely permanent quantity in nature, and is so of physical necessity, for with any alteration the mole-

374

and is so of physical necessity, for with any siteration to mou-cule would cease to be hydrogen coincidence were certain; but Such would be the case if the confidence were certain; but an absolute coincidence can be only a matter of greater or less probability, depending on the resolving power employed, on the number of it hims which correspond, and on their characters. number of the lines which correspond, and on their characters. When the coincidences are very numerous, as in the case of iron and the solar spectrum, or the lines are characteristically grouped, as in the case of hydrogen and the solar spectrum, we may regard the coincidence as certain; but the progress of science has been greatly retarded by resting important conclusions. science has been greatly retarded by resting important conclusions upon the apparent connedence of single lines, in spectroscopes of very small resolving power. In such cases, unless other reasons supporting the connedence are present, the probability of a real coincidence is allost too small to be of any ability of a real consodence is al- out too small to be of any importance, especially in the case of a heavenly body which may lave a motion of approach or of recession of unknown amount. But even here we are met by the confinemon introduced by multiple special, corresponding to different molecular groupings, and the confinemon introduced by multiple special, corresponding to different molecular groupings are considered to the confinement of the

I have said as much as time will permit, and I think indeed sufficient, to show that it is only by the laborious and slow pro cess of most cautious observation that the foundations of the science of celestial physics can be surely laid. We are at present in a time of transition, when the earlier, and, in the nat sent in a time of transition, when the earlier, and, in the nature of things, less precise, observations are giving place to work of an order of accuracy much greater than was formerly considered attainable with objects of such small brightness as the stars.

The accuracy of the earlier determinations of the spectra of

The accuracy of the earlier determinations of the spectra of the terrestrial elements are in most case; inswifcient for modern work on the stars as well as on the sun. They fall much below the reale adopted in Rowland's map of the sun, as well as below the degree of accuracy attained at Potsdam by photography in a part of the spectrum for the brighter stars increase of resolving power very frequently breaks up into groups, in the spectra of the vun and stars, the lines which had been regarded as single, and their supposed coincidences with terrestrial lines fall to the ground. For this reason many of the early conclusions, to the ground. For this reason many of the early concussions, based on observation as good as it was possible to make at the time with the less powerful spectroscopes then in use, may not be found to be maintained under the much greater resolving power of modern instruments

The spectroscope has failed as yet to interpret for us the remarkable spectrum of the Aurora Borealis. Undoubtedly in this phenomenon portions of our atmosphere are lighted up by this phenomenon portions of our atmosphere are figured up by electric discharges we should expect, therefore, to recognize the spectra of the gases known to be present in it. As yet we As yet we the spectra of the gates known to be present in it. As yet we have not been able to obtain smilar spectra from these gases artificially, and especially we do not know the origin of the principal line in the green, which often appears alone, and may have, therefore, an origin independent of that of the other lines. Recently the suggestion has been made that the aurora is a phe-nomenon produced by the dust of meteors and falling stars, and that near positions of certain auroral lines or flutings of man-ganese, lead, barium, thallium, iron, &c , are sufficient to justify games, each garding meteoric dust in the atmosphere as the origin of the auroral spectrum. Liveing and Dewar have made a con-clusive research on this point, by availing themselves of the dust of excessive minuteness thrown off from the surface of electrodes of various metals and meteorites by a disruptive dis-charge, and carried forward into the tube of observation by a more or less rapid current of air or other gas. These experiments more of less rapio current on air or other gas. These experiments prove that metallic dust, however fine, suspended in a gas will not act like gaveous matter in becoming luminous with its characteristic spectrum in an electric dicharge similar to that of the aurora. Prof. Schuster has suggested that the principal the aurora. Prof. Schauter has suggested that the principal line may be due to some very light gas which is present in soo small a proportion to be detected by chemical analysis or even by the spectroscope in the presence of the other gases near the earth, but which at the belight of the auroral discharges is in a sufficiently greater refative proportio; to give a spectrum. Lemstrom, indeed, states that he saw this line in the silent day

charge of a Holtz machine on a mountain in Lapland. The lines may not have been obtained in our laboratories from the atmo-spheric gases on account of the difficulty of reproducing in tabes with sufficient nearness the conditions under which the auroral

discharges take place.

In the spectra of comets the spectroscope has shown the In the spectra of comets the spectroscope has shown the presence of carbon presumably in combination with hydrogen, and also sometimes with nitrogen; and in the case of comets approaching very near the sun, the lines of sodium, and other lines which have been supposed to belong to iron. Though the researches of Prof. II. A. Newton and of Prof. Schuparelli of the prof. II. A. Newton and of Prof. Schuparelli of the prof. II. A. Newton and of Prof. Schuparelli or the prof. II. A. Newton and of Prof. Schuparelli or the prof. II. A. Newton and of Prof. Schuparelli or the prof. II. A. Newton and of Prof. Schuparelli or the prof. II. A. Newton and of Prof. Schuparelli or the prof. II. A. Newton and of Prof. Schuparelli or the prof. II. A. Newton and of Prof. Schuparelli or the prof. II. A. Newton and of Prof. Schuparelli or the prof. II. A. Newton and of Prof. Schuparelli or the prof. II. A. Newton and of Prof. Schuparelli or the prof. II. A. Newton and of Prof. Schuparelli or the prof. II. A. Newton and of Prof. Schuparelli or the prof. II. A. Newton and of Prof. Schuparelli or the prof. II. A. Newton and of Prof. Schuparelli or the prof. II. A. Newton and of Prof. Schuparelli or the prof. II. A. Newton and of Prof. Schuparelli or the prof. II. A. Newton and of Prof. Schuparelli or the prof. II. A. Newton and of Prof. Schuparelli or the prof. II. A. Newton and of Prof. Schuparelli or the prof. II. A. Newton and of Prof. Schuparelli or the prof. II. A. Newton and of Prof. Schuparelli or the prof. II. A. Newton and of Prof. Schuparelli or the prof. II. A. Newton and of Prof. Schuparelli or the prof. II. A. Newton and of Prof. Schuparelli or the prof. II. A. Newton and of Prof. Schuparelli or the prof. II. A. Newton and of Prof. Schuparelli or the prof. II. A. Newton and of Prof. Schuparelli or the prof. II. A. Newton and or the prof. leave no doubt of the close connection of comets with correleave no doubt of the close connection of comets with corre-sponding periodic meteor swarms, and therefore of the probable identity of cometary matter with that of meteorites, with which the spectroscopic evidence agrees, it would be perhaps unwise at present to attempt to define too precuely the exact condition of the matter which forms the nucleus of the comet. In any case the part of the light of the comet which is not reflected solar the part of the light of the counter which is not reflected solar light can excretely be attributed to a high temperature produced by the clashing of separate meteoric stones set up within the nucleus by the sum's disturbing force. We must look rather to disruptive electric discharges, produced probably by processes of evaporation due to increased solar heat, which would be amply sufficient to set free portions of the occluded gases into the vacuum of space. May it be that these duckarges are assuated, sulhcient to set free portions of the ofcolineting master into the accounted passes. May it be that these dischanges are sunsteed, or the utility of the substitution of the unit has been designed and the utility of the unit has been then the substitution of the sun's light? Lenard and Wolfe have shown that ultim-volet light can produce a discharge from a negatively electrified protect of metal, while Hallwachs and Righl have shown further that utility utility land light when a constant protect of the sun's light and the substitution of the supported matter when a const approaches the sun, and help to explain an electrified condition of the exposured matter which would have to return to that point in speaking of the salar corona. A very great advance has been made in our knowledge of the constitution of the sun by the recent work at the Johns Hopkins ultraversity by means of photography and concave graining, in ultraversity by means of photography and concave graining, in directly with the appears of the terreptial excellent power. Growland has shown that the lines of thirty-ax, terrestrial

Rowland has shown that the lines of thirty-six terrestrial Rowland has shown that the lines of thirty-ix terretiral clements at lest-1 are certainly present in the solar spectrum, while eight others are doubtful. Fifteen elements, including intogen as it shows titelf under an electric discharge in a vacuum tube, have not been found in the solar spectrum Some ten other elements, inclusive of oxygeen, have not yet been

Some ten other elements, inclusive of oxygen, have not yet been compared with the sun's spectrum.

Rowland remarks that of the fifteen elements named as not found in the sun, many are so classed because they have few strong lines, or none at all, in the limit of the solar spectrum as The lines of hismuth are compound and to diffuse. Therefore even in the case of these fificen elements there is little evidence

that they are really absent from the sun.

It follows that if the whole earth were heated to the temperature of the sun, its spectrum would resemble very closely the

ture of the sun, its -pectrum would resemble very closely the old a spectrum of the sun the terrestrial elements in the sun

the terrestrial elements in the sun. Best results of eleven years of Siss in a recent paper gives the in a state of party, and on the possibility of decomposing them by the physical and chemical forces at our disposal. His experiments on calcium, strontum, lithium, magnesium, silver, sodium, and thallium, show that these substances reatm their individuality under all conditions, and are unalterable by any forces that we can bring to bear upon

Prof. Rowland looks to the solar lines which are unaccounted for as a means of enabling him to discover such new terrestrial elements as still lurk in rare minerals and earths, by confronting their spectra directly with that of the sun. He has already resolved yttrium spectroscopically into three components, and

actually into two. The comparison of the results of this indeactually into two. The comparison of the results of this inde-pendent analytical method with the renarkable but different conclusions to which M. Lecoq de Boisbaudran and Mr. Crookes have been led respectively, from spectroscopic observation of these bodies when glowing under molecular bombardment in a vacuum tube, will be awaited with much interest. It is worthy remain tune, will be awaited with much interest. It is worthy of remark that, as our knowledge of the spectrum of hydrogen in its complete form came to us from the stars, it is now from the san that chemistry is probably about to be enriched by the dis-

covery of new elements. In a discussion in the Bakerian Lecture for 1885 of what we knew up to that time of the sun's corona, I was led to the conclusion that the corona is essentially a phenomenon similar in the cause of its formation to the tails of comets-namely, that it the cause of its formation to the tails of comets—namely, that it consists for the most part probably of matter going from the sen under the action of a force, possibly electrical, which vance as the surface, and can therefore in the case of highly attenuated matter easily master the force of gravity even near the san Though many of the coronal particles may return to the sun, those which form the long rays or streamer do not return; they separate and soon become too diffused to be any longer variety. and may well go to furnish the matter of the zodiacal light, which and may well go to turnish the matter of the zontacal light, which otherwise has not received a satisfactory explanation. And further, if such a force exist at the sun, the changes of terrestrial magnetism may be due to direct electric action, as the earth moves through lines of inductive force.

These conclusions appear to be in accordance broadly with the lines along which thought has been directed by the results of subsequent eclipses. Prof. Schuster takes an essentially similar view, and suggests that there may be a direct electric connection between the sun and the planets. He asks further whether the between the sun and the planets. He asks further whether the sun may not act like a magnet in consequence of its revolution about its axis. Prof Bigelow has recently treated the coronal forms by the theory of spherical harmonics, on the supposition that we see phenomena similar to those of free electricity, the rays being lines of force, and the coronal matter discharged from rays being lines of force, and the coronal matter dascharged from the tan, or at least arranged or controlled by these forces. At power may be lost, and gravitation set in, bringing the matter lost to the sun. The mitter which does lever the sun sper-naturely transported to the equatorial plane of the corona, in attack the sun attention of the coronal plane of the coronal in the sun spering the sun attention of the sun sper-naturely transported to the equatorial plane of the coronal. In tancer from the sun along this equator of such like material Photographs on a larger scale will be destrable for the full development of the conclusions which may follow from the natively of the curved forms of the coronal structure. Prof Schaeberle, of the curvest form of the coronal structure. Froi Scinaevite however, considers that the coronal phenomena may be satisfactorily accounted for on the supposition that the corona is formed of streams of matter ejected mainly from the spot zones with great initial velocities, but smaller than 33z miles per second Puriber that the different types of the corona are due to the effects of perspective on the streams from the earth's place at the time relatively to the plane of the solar equator

Of the physical and the chemical nature of the coronal matter we know very little. Schuster concludes, from an examination of the eclipses of 1882, 1883, and 1886, that the continuous spectrum of the corona has the maximum of actinic intensity displaced considerably towards the red when compared with the spectrum of the sun, which shows that it can only be due in spectrum of the sun, which shows that it can only be due in small part to solar light scattered by small particles. The lines of calcium and of hydrogen do not appear to form part of the normal spectrum of the corona. The green coronal line has no known représentative in terrestrial sub-tances, nor has Schuster been able to recognize any of our elements in the other lines of the corons.

The spectra of the stars are almost infinitely diversified, yet they can be arranged with some exceptions in a series in which the adjacent spectra, especially in the photographic region, are scarcely distinguishable, passing from the bluish-white stars like Sirius, through stars more or less solar in character, to stars with banded spectra, which divide themselves into two apparently independent groups, according as the stronger edge of the bands is towards the red or the blue. In such an arrangement the

sun's place is towards the middle of the series.

At present a difference of opinion exists as to the direction in the series in which evolution is proceeding, whether by further condensation white stars pass into the orange and red stages, or whether these more coloured stars are younger and will become white by increasing age. The latter view was suggested by white by mcreasing age. Johnstone Stoney in 1867

NO. 1138, VOL. 44]

About ten years ago Ritter in a series of papers discussed the behaviour of gaseous masses during condensation, and the probable resulting constitution of the heavenly bodies. Accordprobable resulting constitution of the heavenly bodies. According to him, a size passes through the orange and red stages are proposed to the proposed of the constitution of the proposed stage, and a second time during a more prolonged stage of gradual cooling. He suggested that the two groups of bandes stars may correspond the proposed stage of gradual cooling. He suggested that the two groups of bandes stars may correspond the stage of the s

Recently a similar evolutional order has been suggested, which is based upon the hypothesis that the nebulæ and stars consist of colliding meteorie stones in different stages of condensation. of colliding meteorie stones in different stages of condensation. More recently the view has been put forward that the diversified spectra of the stars do not represent the stages of an evolutional progress, but are due for the most part to differences of original constitution.

The few minntess which can be given to this part of the address are insufficient for a discussion of these different views I purpose, therefore, to state briefly, and with reserve, as the I purpose, therefore, to state briefly, and with reserve, as the subject is obscure, some of the considerations from the characters as the consideration from the characters are considerated by the consideration of the consideration of the stars from their photographic spectrum in 1879. In Sorder is essentially the same as Vogel had previously proposed in his classification of the stars as Vogel had previously proposed in his classification of the stars as Vogel had previously proposed in his classification of the stars in 1874, in which the white stars, which are most numerous, represent the early adult and most persistent stage of stellar life, the solar condition that of full maturity and of commencing age; while in the orange and red stars with banded spectra we see the while in the orange and red stars with bandes spectra we see the setting in and advance of old age. But this statement must be taken broadly, and not as asserting that all stars, however different in mass and possibly to some small extent in original constitution, exhibit one invariable succession of spectra.

In the spectra of the white stars the dark metallic lines are relatively inconspicuous, and occasionally absent, at the same time that the dark lines of hydrogen are usually strong, and more or less broad, upon a continuous spectrum, which is remarkable for its brilliancy at the blue end. In some of these stars the hydrogen and some other lines are bright, and sometimes variable

As the greater or less prominence of the hydrogen lines, dark or bright, is characteristic of the white stars as a class, and diminishes gradually with the incoming and increase in strength of the other lines, we are probably justified in regarding it as due to some conditions which occur naturally during the pro-gress of stellar life, and not to a pecuharity of original consti-

To produce a strong absorption spectrum a substance must be at the particular temperature at which it is notably absorptive; and, further, this temperature must be sufficiently below that of the region behind from which the light comes for the gas to the region behind from which the light comes for the gas to spear, so for as in special rays are concerned, as darkness upon spear, so for as in special rays are concerned, as darkness upon be raised before it can also wit is characteritic emission and short feelbieness or absence of the other lines, not to the passety of the feelbieness or absence of the other lines, not to the passety of the substances behind them as to show rebelly, if all all, by reversion Such a state of things would more probably be found, it seems to me, in conduction attentor to the solar size. A considerable eooling of the sun would probably give rise to banded spectra due to compounds, or to more complex molecules, which might form near the condensing points of the vapours

form near the condensing points of travelor as consisting of glow-ing vapours surrounded by a photosphere where condensation is taking place, the temperature of the photospheric layer from which the greater part of the radiation comes being constantly renewed from the hotter matter within.

At the surface the convection currents would be strong, pro-dueing a considerable commotion, by which the different gases would be mixed and not allowed to retain the inequality of proportions at different levels due to their vapour densities

Now the conditions of the radiating photosphere and those of the gases above it, on which the character of the spectrum of a the gases above it, on which the character of the spectrum of a star dependar, will be determined, not alone by temperature, but also by the force of gravity in these regions; this force will be fixed by the star's mass and its stage of condensation, and will become greater as the star continues to condense.

In the case of the sun the force of gravity has already become In the case of the sun the force of gravity has already become or great at the surface that the decrease of the density of the gaves must be extremely rapid, passing in the space of a few miles from atmosphere pressure to a density infaintesimally small; consequently the temperature gradient at the surface, if determined solely by expansion, must be extremely rapid. The gases here, however, are exposed to the fierce radiation of the if any solid or liquid particles were present from condensation or

convection currents. convection currents.

From these causes, within a very small extent of space at the surface of the sun, all bodies with which we are acquainted should fall to a condition in which the extremely tenuous gas could no longer give a visible spectrum. The insignificance of snound tail to a constituen in which the extremely tensious gas could no longer give a visible spectrum. The insignificance of the single subtended by this spice as seen from the earth should cause the boundary of the solar atmosphere to appear defined. If the boundary which we see he that of the sun proper, the matter above it will have to be regarded as in an essentially dynamical condition—an assemblage, so to speak, of gaseous pro-jectiles for the most pair failing back upon the sun after a greater or less range of flight. But in any case it is within a space of relatively small extent in the sun, and probably in the other solar stars, that the reversion which is manifested by dark

lines is to be regarded as taking place
Passing backward in the star's life, we should find a gradual weakening of gravity at the surface, a reduction of the tempera ture gradient so far as it was determined by expansion, and con-vection currents of less violence producing less interference with he proportional quantities of gases due to their vapour densities. while the effects of cuptions would be more extensive

while the effects of captions would be more extensive At last we might come to a state of things in which, if the star were hot enough, only hydrogen might be sufficiently cool relatively to the mistianto behind to produce a strong absorption. The lower vapours would be protected, and might continue to be relatively to the scholer, their hotse might be possible as be relatively to the scholer, their lines might be possible as continuous spectrum, besides, their lines might be possible as the scholer before the configurations scheric unthe vapours themselves of a continuous spectrum

In such a star the light radiated towards the upper part of the atmosphere may have come from portions lower down of the atmosphere many have come from portions lower down of the atmosphere itself, or at least from parts not greatly hotter. There may be no such great difference of temperature of the low and less low portions of the star's atmosphere as to make the darkening effect of absorption of the protocted metallic vapours. to prevail over the illuminating effect of their emission,

It is only by a vibratory motion corresponding to a very high temperature that the bright lines of the first spectrum of hydro temperature that the bright lines of the first spectrum of hydro-gen can be brought out, and by the equivalence of absorbing and emitting power that the corresponding spectrum of absorption should be produced, yet for a strong mbsorption to show it-olf, the hydrogen must be cool relatively to the source of redulation behind it, whether this be condensed particles or gas. Saeli conditions, it seems to me, should occur in the earlier rather than in the more advanced singer of condensation.

The subject is obscure, and we may go wrong in our mode of conceiving of the probable progress of events, but there can be no doubt that in one remarkable instance the white-star spectrum is associated with an early stage of condensation.

Sirius is one of the most conspicuous examples of one type of this class of stars Photometric ob cryations combined with its ascertained parallax show that this star emits from forty to sixty times the light of our sun, even to the eye, which is insensible to ultra-violet light, in which Sirius is very rich, while we learn from the motion of its companion that its mass is not much from the motion of its companion that its mass is not much more than double that of our sun. It follows that, unless we attribute to this star an improbably great emissive power, it must be of immense sue, and in a much more diffuse and there-fore an earlier condition than o it sun; though probably at in later stage than those white stars in which the hydrogen lines are bright.

A direct determination of the relative temperature of the photospheres of the stars might possibly be obtained in some cases from the relative position of maximum radiation of their cases not the error position in maximum a standard or the continuous spectra. Langley has shown that through the whole range of temperatures mobile we can experiment, and presume ably at temperatures beyond, the maximum of radiation-power has solid bodies gradually shifts upwards in the spectrum from the infra-red through the red and orange, and that in the sun it has reached the blue.

The defined character, as a rule, of the stellar lines of absorp-

NO. 1138, VOL. 44]

tion suggests that the vapours producing them do not at the tion suggests that the vapour producing them do not at the tome time excet any strong power of general absorption. Con-sequently, we should probably not go far wrong, when the pho-tosphere consusts of luquid or solid particles, if we could compare select parts of the continuous spectrum between the stronger lines, or where they are fewers. It is obvious that, if extended portions of different stellar spectra were compared, their true

relation would be obscured by the line-absorption. relation would be obscured by the line-absorption.

The increase of imperiator, as shown by the rise in the pectrum of the maximum of radiation, may not always be accompanied by no corresponding greater brightness of a star as estimated by the eye, which is an extremely imperfect photometric astrument. Not only a time eye blind to large regions of radiation, but even for the small image of light that we can use the contract of the contract of the contract of the contract of radiation, but even for the small image of light that we can use the contract of the contract of radiation, but even for the small range of light that we can use the contract of the contract see the visual effect varies enormously with its colour. According to Prof. Langley, the same amount of energy which just caables us to perceive light in the crimion at A would in the green produce a visual effect 100,000 times greater. In the violet the proportional effect would be 1600, in the blue 50,000, in the yellow 30,000, in the orange 14,000, and in the ref 1200. in the yellow 25,000, in the orange 14,007, and in the real ratio. Captain Abney's recent experiments make the sensitiveness of the eye for the green near F to he 750 times greater than for the red about C It is for this reason, at least in part, that I suggested in 1864, and have since shown by direct observation, that the

in 1804, and have since shown by direct observation, that the spectrum of the nebula in Andromeda, and presumably of similar nebular, is in appearance, only weather the the second of the specific properties of would increase in visual brightness, but not in proportion to the increase of energy radiated by it

The brightness of a star would be affected by the nature of the substance by which the light was chiefly emitted. In the laboratory, solid carbon exhibits the highest emissive power A laboratory, solic caroon exhibits the nignest emissive power stellar stage in which radiation comes, to a large extent, from a photosphere of the solid particles of this substance, would be favourable for great brilliancy. Though the stars are built up of matter essentially similar to that of the sun, it does not follow that the proportion of the different elements is everywhere the same. It may be that the substances condensed in the photospheres of different stars may differ in their emissive powers, but

probably not to a great extent

All-the heavenly hodies are seen by us through the tinted medium of our atmosphere. According to Langley, the solst stage of stars is not really yellow, but, even as gauged by our imperfect eye, would appear blush-white if we could free our-selves from the deceptive influences of our surroundings. From these considerations it follows that we can scarcely

infer the evolutional stages of the stars from a simple comparison mer en erviucional stages of mestan from a simple comparison of their eye magnitudes. We should expect the white stars to be, as a class, less dense than the stars in the solar stage. As great mass imply bring in the solar type of spectram at a relatively earlier time, some of the brightest of these stars may be very massive, and builder than the sum-for example, the bril very measure, and brighter that the sun—for example, the brilliant star Arcturus. For these reasons the solar stars should not only be dense than the white stars, but perhaps, as a class, surpass them in mans and eye-brightness. It has been shown by Lane that, so long as a condensing gaseous mass remains subject to the laws of a purely gaseous.

body, its temperature will continue to rise

he greater or less breadth of the lines of absorption of hydrogen in the white stars may be due to variations of the

hydrogen in the white stars may be due to variations of the depth of the hydrogen in the inter-of sight, armang from the case throughout the control of the case throughout the case through the case throughout throughout the case throughout the case throughout the ca anto which they have been davided by Vogel, Scheiner has re-cently investigated minor differences as suggested by the charac-cently investigated minor differences as suggested by the charac-too, that so far as his observations go the white stars in the constitution of from stand done, with the exception of Algoi, as passessing dark ince in the blue which has appearently the superior of the contract of the superior of the spectra of the spectra of these stars dark lines corresponding to the principal lines of the beright-line stars, and the planetary neutics with the

exception of the chief nebular line. The association of whatestaw with nebular matter in Orion, in the Pickides, in the region of the Milky Way, and in other parts of the heavest, may be regarded as falling in with the view that I have taken. In the stars possibly further reasoned from the with exception in the stars possibly further reasoned from the withen class than the stars of the stars, which are distinguished by absorption bands with their stronger edge towards the blue, the hydrogen lines are narrower than in the solar spectrum. In these stars, the density-gradient is more probably still more rapid, the depth of hydrogen may be less, the star of the stars of encounters with dissuminar mole state. In you have not a star with dark hydrocarbon bands, the hydrogen lanes have not been certainly observed; if they are really absent, it may be because the temperature has fallen below the point at which hydrogen can essert its characteristic absorption, besides, some the hydrocarbon bands may indicate a later evolutional stage, but the electric are.

the electric arc.

A number of small stars more or less similar to those which are known by the names of their discoverers, Wolf and Rayet, are known by the names of their discoverers, Wolf and Rayet, have been found by Pickering in his photographs. These are remarkable for several brillast groups of bright lines, including special properties of the properties of th nebula, the bright groups being due to the gaseous matter out side the star. Mr. Robeits, however, has not been able to bring out any indication of nebulosity by prolonged exposure. The remarkable star n Argis may belong to this class of the beavenly bodies.

In the nebules, the elder Herschel saw portions of the first must or "thanning fluid" out of which the heaven and the earth had been slowly fashioned. For a time this view of the nebules gave place to that which regarded them as external galaxies, comment "sand heaps," too remote to be resolved into separate sizes; though mided, in 1883, Mr. Herbert Speacer showed that the observations of nebulæ up to that time were really in favour

the observations of nebular up to that tune were really in favour of an evolutional progress
In 1864, I brought the spectroscope to bear upon them, the bright times which thanked upon the eyes showed the source of the bright times which thanked upon the eyes showed the source of the tap thanked the source, as an early stage of sidereal life at the probably their true place, as an early stage of sidereal life. At that early time our knowledge of sidelar spectra was small For this reason partly, and probably also under the undue under the undue under the control of the stage of the sta no longer have to an whina special modification or our own type of sun, but find ourselves in presence of objects possessing a distinct and peculiar plan of structure." Two years later, however, in a lecture before the Association, I took a truer position "Our views of the universe," I said, "are undergoing

ton "Our views of the universe," I said, "are undergoing important changes, let us wast for more facts, with minds unfettered by any dogmatic theory, and therefore free to receive the teaching, whatever it may be, of new observations." Let us turn saide for a moment from the nebulis in the sky to the conclusions to which philosophers had been resultily led the conclusions to which philosophers had been resultily led to the conclusions of which philosophers had been resultily led to the conclusions of which will be the conclusions of the co aggregation of bodies, but a system resting upon a multitude of relations pointing to a common physical cause. From these considerations Kant and Laplace formulated the nebular hypothesis, resting it on gravitation alone, for at that time the science of the conservation of energy was practically unknown. These of the conservation of case in the supposition that the space now occupied by the solar system was once filled by a vaporus mass, the formation of the sun and planets could be reasonably ac counted for

By a totally different method of reasoning, modern science by a totally dimercial mention of reasoning modern science traces the solar system backward step by step to a similar state of things at the beginning. According to Helmboltz, the sun'a heat is maintained by the contraction of his mass, at the rate of about 220 feet a year. Whether at the present time the sun is getting hotter or colder we do not certainly know. We can reason back to the time when the sun was sufficiently expanded reason back to the time when the san was subnemity expanded to fill the whole space occupied by the volar system, and was reduced to a great glowing nebula. Though man's life, the life of the rose perhaps, it so short to give us direct evidence of any distinct stagges of so august a process, still the probability is great that the nebular hypothesis, especially in the more precise form given to it by Koche, does represent broadly, notwithstanding some difficulties, the succession of events through which the

ing some united that is a sun and planets have passed

The nebular hypothesis of Laplace requires a rotating mass of fluid which at successive epochs became unstable from excess of motion, and left behind rings, or more probably perhaps lumps, of matter from the equatorial regions.

The difficulties to which I have referred have suggested to some thinkers a different view of things, according to which it is not necessary to suppose that one part of the system gravita-tionally supports another. The whole may consist of a congeries of discrete bodies even if these bodies be the ultimate molecules of matter. The planets may have been formed by the gradual of the condensing solar system consisted of separate particles or or masses, we have no longer the fluid pressure which is an essential part of Laplace's theory. Faye, in his theory of evolution fro is meteorites, has to throw over this fundamental idea of the nebular hypothesis, and he formulates instead a different succession of events, in which the outer planets were formed last, a theory which has difficulties of its own

Prof George Darwin has recently shown, from an investigaon certain assumptions a meteoric swarm might behave as a coarsegas, and in this way bring back the fluid pressure exercised by one part of the system on the other, which is required by Laplace's theory One chief assumption consists in supposing Laplace's theory One chief assumption consists in supposing that such inelastic bodies as meteoric stones might attain the effective elasticity of a high order which is necessary to the theory through the sudden volatilization of a part of their mass at an encounter, by which what is virtually a violent explosive is introduced between the two colliding stones Prof Darwin is careful to point out that it must necessarily be obscure as to how a small mass of solid matter can take up a very large amount of energy in a small fraction of a second

energy in a small fraction of a second.
Any direct indications from the heavens themselves, however, slight, are of so great value, that I should perhaps in this consistence of the control of all retirementable photograph, by Mr. Roberts, of the great is beabla in Andromedia. On this plate we seem to have presented to us some stage of contained evolution on a gigantic scale. The photograph shows a sort of white pool disturbance of the luminous matter which is distributed in a plane inclined to the line of sight, in which a series of rings of bright inclined to the line of vigit, in which a series of rings of bright matter exparated by dark spaces, greatly foreinbortened by per-manent of the parallex of this nebula, but there can be little uponant of the parallex of this nebula, but there can be little cloubt that we are looking upon a system very remote, and libera-fure of a magnitude great beyond our power of adequate com-prehencing. The matter of this nebula, in whatever state it may be, appears to be distributed, as in so many other nebulæ. in rings or spiral streams, and to suggest a stage in a succession of evolutional events not inconsistent with that which the nebular procliness requires. To likes this object more directly to any particular stage in the formation of particular stage in the formation of particular stage in the formation of the compare thing; great with small," and might be indeed to introduce a false analogy; but, on the other hand, we should err through an excess of ceution if we did not accept the remarks be features brooght to light by this photograph as a presumptive indication of a progress of events in cosmical history following broadly upon the fines of Lappiese's theory.

The old were of the original matter of the reluin, that it consisted of a "fire" mist, "".

"a tumultuous cloud Instinct with fire and aitre."

fell at once with the rise of the science of thermodynamics. fell at once with the rase of the science of thermodynamics. In 1654, Helinholts showed that the supportion of an original fiery condition of the neshboard stuff was unnecessary, stace in the potential energy sufficient to generate the high temperature of the sun and stars. We can scarcely go wrong in attributing the high of this neshboard control of the gravitational energy of shrankage into molecular motion. The side, that the light of comets and of nebulae may be due

to a succession of Ignited flashes of gas from the encounters of meteoric stones was suggested by Prof. Tait, and was brought to the notice of this Association in 1871 by Sir William Thomson

the notice of this Association in 1871 by Sir William Thomson in his Presidential Address.

The spectrum of the bright-line nebulæ is certainly not such a spectrum as we should expect from the flashing by collisions of meteorities similar to those which have been analyzed in our meteorities smillar to those which have been analyzed in our laboratories. The strongest inse of the substances which in the case of such meteorities would first show themselves, fron, sodium, mageneum, micele, &c., are not those which distinguish the nebalar spectrum. On the contrary, this spectrum is chiefly remarkable for a few brilliant innex, very narrow and defined, upon a lackground of a faint continuous spectrum, which contains namerous bright lines, and probably some lines of contains namerous bright lines, and probably some lines of absorption.

assopption.

The two most conspicuous lines have not been interpreted; for though the second line falls near, it is not consedied with a strong double line of iron. It is hardly necessary to say that though the near position of the bughet cloudle line of inforger, as seen in a small spectroscope in 1864, naturally suggested at that early time the possibility of the presence of this element in the nebula, I have been careful to point

sence of this element in the nebulz, I have been careful to point out, to preven imasprehension, that in more recent years the introgen lines and subsequently a lead line have been employed. The third line we know to be the excoold line of the first appearum of hydrogen. In Keeler has seen the first hydrogen line in the red, and photographs show that this hydrogen spectrum of substitution of the white first appearance of the hydrogen line first l

We are not surprised to find associated with it the line D₃, near the position of the absent sodium lines, probably due to the atom of some unknown gas, which in the sun can only show

near the position of the absent sociam lines, probably due to the intelligination of the absent social lines are intelliginated in the continuity of highest temperature, and for that reason does not reveal tutelf by absorption in the solar spectrum. It is not unreasonable to assume that the two brightest lines, which are of the same order, are produced by substances of a similar nature, in which a vibratory motion corresponding to a similar analysis, in which a vibratory motion corresponding to a few unknown elements which are wanting in our terrestral chemistry between hydrogen and lithium, unless indeed $D_{\rm h}$ to the lightest aid of hydrogen. The contract of the contract

small number of luminous molecules or atoms would probably be sufficient to make the nebulic as bright as they appear to us. On such an assumption the average temperature may ic low, but the individual particles, which by their encounters are luminous, must have motions corresponding to a very high temperature. and in this sense be extremely hot

In such diffuse masses, from the great mean length of free path, the encounters would be are but correspondingly violent, and tend to bring about vibrations of comparatively short period, as appears to be the case if we may judge by the great relative brightness of the more refrangible lines of the nebular

spectrum. Such a view may perhaps reconcile the high temperature which Such a view may pernapa reconcile the high temperature which the nebular spectrum undoubtedly suggrests with the much lower mean temperature of the gaseous mass, which we should expect at so early a stage of condensation, unless we assume a very enormous mass; or that the matter coming together had previously considerable motion, or considerable molecular agitation.

The inquisitiveness of the human mind does not allow us to

remain content with the interpretation of the present state of the cosmical masses, but suggests the question-

"What see'st thou else In the dark backward and abyon of time"

What was the original state of things? how has it come about that by the side of ngeing worlds we have nebulæ in a relatively jounger stage? Have any of them received their birth from dark suns, which have collided into new life, and so belong to a second or later generation of the heavenly bodles?

During the short historic period, indeed, there is no record of

such an event; still it would seem to be only through the collision of dark suns, of which the number must be increasing, that a temporary rejuvenescence of the heavens is possible, and by such abblings and flowings of stellar life that the inevitable end to which evolution in its apparently uncompensated progress is carrying us can, even for a little, be delayed

We cannot refuse to admit as possible such an origin for

nebula

nebulæ
In considering, however, the formation of the existing nebulæ
we must bear in mind that, in the part of the heavens within
our ken, the stars still in the early and middle stages of evolution
exceed greatly in number those which appear to be in an
advanced condition of condensation. Indeed, we find some stars which may be regarded as not far advanced beyond the nebular condition

It may be that the cosmical bodies which are still nebulous owe their later development to some conditions of the part of owe their later development to some conditions of the past of pasce where they occur, such as, concribably, a greater original homogeneity, in consequence of which concleasation began itself the past of the pas connected with it.

connected with it.
If light matter be suggested by the spectrum of these nebular, it may be asked further, as a pure speciation, whether in them we are wintening possibly a later condensation of the light representation of the light present proportion, after the first growth of worlds into which he heaver matter condensed, though not without some entanglement of the lighter substances. The write extent and great diffusiones of the highly the nebularly over a large part of the constitution of Orno may be regarded perhaps as pointing in this direction. The diffuse orbitons matter streaming round the rais direction — The diruse neonious matter streaming round the Pleiades may possibly be another instance, though the character of its spectrum has not yet been accertained.

In the planetary nebulæ, as a rule, there is a sensible increase

of the faint continuous spectrum, as well as a slight thickening of the bright lines towards the centre of the nebula, appearances which are in favour of the view that these bodies are condensing

Prof G Darwin, in his investigation of the equilibrium of a rotating mass of fluid, found, in accordance with the independent researches of Poincaré, that when a portion of the central body becomes detached through increasing angular velocity, the portion should bear a far larger ratio to the remainder than is observed in the planets and satellites of the solar system, even thus the compact had been a compact and satellites of the solar system, even taking into account heterogeneity from the condensation of the parent mass

parent mass

Now this state of things, in which the masses though not equal are of the same order, does seem to prevail in many enables, and to have given borth to a large class of lineary stars. Mr. See has recently investigated the evolution of bodies of this man, and the same continuous of the same continuous stars. The same continuous parent me to the relatively large mass-ration of the component bodies, as well as in the high econtricities of their orbits brought shout by tidal fraction, which would play a more important part in the evolution of such systems. Considering the large number of these bodies, he suggests that the solar system should perhaps no longer be regarded as representing cettalli evolution in its normal form—

A goodly Paterne to whose perfect mould He fashioned them

but rather as modified by conditions which are exceptional.

It may well be that in the very early stages condensing masses are subject to very different conditions, and that condensation may not always begin at one or two centres, but sometimes set in at a large number of points, and proceed in the different cases along very different lines of evolution

Besides its more direct use in the chemical analysis of the heavenly bodies, the spectroscope has given to us a great and unexpected power of advance along the lines of the older astronomy. In the future, a higher value may, indeed, be placed upon this indirect use of the spectroscope than upon its chemical rescletions

By no direct astronomical methods could motions of approach or of recession of the stars be even detected, much less could they be measured. A body coming directly towards us or going directly from us appears to stand still. In the case of the stars we can receive no assistance from change of size or of brightness The stars show no true disks in our instruments, and the nearest of them is so far off that if it were approaching us at the rate of a hundred miles in a second of time, a whole century of such rapid approach would not do more than increase its brightness by the one-fortieth part.

by the one-fortisth part. Still it was only too clear that, so long as we were mable to Still it was only too clear that, so long as we were mable to Still it was only too clear that the still it was one too the solid that the liter of sight, the speed and direction of the solid that the still it was too the solid that the still it was to the solid that the still it was to the still it was to solid the has wen, must remain more or less imperfedly prower, which, though so essential, appered almost the nature of things to lie for ever beyond our grasp; it enables us measure directly, and under favorable currountanest to within a mile per second, or even less, the speed of approach or of recession of a heavenly body. This method of observation has recession of a heavenly body. This method of observation has the great advantage for the astronomer of being independent of the distance of the moving body, and is therefore a applicable and as certain in the case of a body on the extreme confines of the visible universe, so long as it is bright enough, as in the case

the visible universe, to long as it is origin enough, so in increase of a neighbouring planet.

Doppler had suggested as far back as 1841 that the same principle, on which he had shown that a sound should become sharper or flatter if there were an approach or a recession between the car and the source of the sound, would apply equally to light; and he went on to say that the difference of colour of some of the binary stars might be produced in this way by their motions. Doppler was right in that the principle is true in the case of light, but he was wrong in the particular conclusion which he drew from it. Even if we suppose a star conclusion which he drew from it. to be moving with a sufficiently enormous velocity to after sensibly its colour to the eye, no such change would actually be seen, for the reason that the store of invisible light beyond both mits of the visible spectrum, the blue and the red, would be drawn upon, and light waves invisible to us would be exalted or degraded so as to take the place of those raised or lowered in the visible region, and the colour of the star would remain unchanged. About eight years later Fireau pointed out the importance of considering the individual wave lengths of which importance of considering the individual wave tengths of which white light is composed. As soon, however, as we had learned to recognize the lines of known substances in the spectra of the heavenly bodies, Doppler's principle became applicable as the bass of a new and most fruitful method of investigation. This measurement of the small shift of the celestial lines from their measurement of the small shift of the celestial lines from their measurement of the small shift of the celestral lines from their rule positions, as shown by the same lines in the spectrum of a terrestrial substance, gives to us the means of ascertaining directly in miles per account the speed of approach or of recasion of the heavenly body from which the light has come Anaecount of the first application of this method of research to the stars, which was made in my observatory in 1865, and the start of the start, which was made in my observatory in 1865, and the start of the start of

given by Sit Usarret Stokes from tails chair at the meeting at Lexter in 1859. The stellar motions determined by me were shortly after confirmed by Prof. Vogel in the case of Sirus, and in the case of other stars by Mr. Christie, now Astronomer Royal, at Greenwich, but, necessarily, in consequence of the madequacy of the instruments then in use for so delicate an inquiry, the amounts of these motions were but approximate.

The method was shortly afterwards taken np systematically at Greenwich and at the Rugby Observatory. It is to be greatly regretted that, for some reasons, the results bave not been sufficiently accordant and accurate for a research of such exceptional ciently accordant and accurate for a research of such exceptional delicacy. On this account probably, as well as that the spectro-scope at that early time had scarcely become a familiar ustrument in the observatory, astronomers were allow in availing themselves of this new and remarkable power of investigation. That this comparative neglect of so truly wonderful a method of ascortaining what was other wise outside our powers of observaascertaming what was otherwise outside our powers or observa-tion has greatly retarded the progress of astronomy during the last fifteen years, is but too clearly shown by the brilliant result-which within the last couple of years have followed fast upon the recent masterly application of this method by photography

at Production, and by see with the readel accuracy at the Left Departure. As the last this used to be sectioned to the last the place as one of the most potent methods of astronomical research. It gives as the motions of approach and of recession, not in angular measures, which depend for their translation into not in an agree which depend for their translation into the last translation and the last translation of the l

to look for the more important discoveries in sidereal astronomy which will be made during the coming century.

In his recent application of photography to this method of determining celestial motions, Prof. Vogel, assisted by Dr. Scheiner, considering the importance of obtaining the spectrum
of as many stars as possible on an extended scale without an exposure inconveniently long, wisely determined to limit the part of the spectrum on the plate to the region for which the ordinary silver-bromide gelatine plates are most sensitive—namely, to a small distance on each side of G—and to employ as namely, to a small datance on each sale of G—and to employ as the line of comparison the hydrogen line near C, and recently also certain lines of iron. The most ninute and complete mechanical arrangements were provided for the purpose of securing the absolute rigidity of the comparison spectrum rela-tively to that of the star, and for permitting temperature adjustments and other necessary ones to be made.

The perfection of these spectra is shown by the large number of lines, no fewer than 250 in the case of Capella, within the small region of the spectrum on the plate Already the motions of about fifty stars have been measured with an accuracy, in the case of the larger number of them, of about an English mile per second

At the Lick Observatory it has been shown that observations can be made directly by eye with an accuracy equally great.

Mr. Keeler's brilliant success has followed in great measure from the use of the third and fourth spectra of a greating 14.438 lines The marvellous accuracy attainable in his hands to the mch on a suitable star is shown by observations on lince nights of the star Arcturus, the largest divergence of his measures being not greater than six tenths of a mile per second, while the mean of the three nights' work agreed with the nican of five photographic determinations of the same star at Potslam to within one-tenth of an highsh mile. These are determinations of the motions of a sin so stupendoesly remote that even the method of parallax practically fails to findnen the depth of intervening space, and by mile that the same star of the same star determinations of the same star at Potsdam to within one-tenth

line of signt of lowne values passes, and considerable motion in space, if the values respected that nebulae considerable motion in space, if the best elider motions must have belonged to the nebule out of which they have been revolved. We may be the special passes when the special passes were specially materially in the semination of the motions greater than twenty five miles per second, were unsufficient. Mr. Keller has found in the examination of tensificated, which receives the special passes which were the

nebula, of vast extent and of extreme tenuty, is probably more nearly at rest relatively to the stars of our system than any other celestial object we know, still it would seem more likely that cerestian object we know, still it would seem more likely that even here we have some motion, small though it may be, than that the motions of the matter of which it is formed were so absolutely balanced as to leave this nebula in the unique position of absolute immobility in the unique of whirling and drifting sums and systems of suns.

and systems of suns.
The apperiors but of of determining criestal motions 1.
The apperiors in could be been failed in a wew but not allogather understeen detection, for it has, so to speak, given in a separating power far beyond that of any televoop the glass maker and the optician could construct, and so enabled us to support the could be supported by the could be supported by the support of the support of

of stellar systems, in which the components are in some eases of nearly equal magnitude, and in close proximity, and are re-volving with velocities greatly exceeding the planetary valocities

volving with verocines grown, of our system.

The K line in the photographs of Mizar, taken at the Harvard College Observatory, was found to be double at intervals of College Observatory, was found to be double at intervals of the college Observatory. fifty-two days. The spectrum was therefore not due to a single source or ught, but to the combined effect of two stars moving periodically in opposite directions in the line of sight, It is obvious that if two stars recolve round their common centre of gravity in a plane not perpendicular to the line of sight, all the lines in a starting common centre. source of light, but to the combined effect of two stars moving lines in a spectrum common to the two stars will appear alternately single or double.

In the case of Mizar and the other stars to be mentioned, the spectroscopic observations are not as yet extended enough to furnish more than an approximate determination of the element-

of their orbits

Mizar especially, on account of its relatively long period-about 105 days-needs further observations. The two stars are moving each with a velocity of about fifty miles a second, probably in elliptical orbits, and are about 143 millions of miles apart. The stars, of about equal hightness, have together a

apart. Inc stars, or about equal transfer and mass about forty times as great as that of our sun.

A similar doubling of the lines showed itself in the Harvard. A similar doloring of the inica showed user in the same re-photographs of \(\theta\) Aurige at the remarkably close interval of almost exactly two days, indicating a period of revolution of about four days. According to Vogel's later observations, each star has a velocity of nearly seventy miles a second, the distance between the stars being little more than seven and a half mil-lions of miles, and the mass of the system 4'7 times that of the sun. The system is approaching us at the speed of allout sixteen

The telescope could never have revealed to us double stars of this order. In the case of \$\beta\$ Auriga, combining Vogel's distance with Pritchard's recent determination of the star's parallax, the greatest angular separation of the stars as seen from the earth greatest angular separation of the stars as seen from the earth would be 1/200 part of a second of ace, and therefore very fire too small for the highest powers of the largest telescopes. If we take the relation of aperture to separating power usually accepted, an object glass of about 80 feet in dismeter would be needed to restolve this binary star. The spectroscope, which takes no note of distance, magnifies, so to speak, this minute angular separation 4000 times, in other words, the doubling of the spectrum of the second seco the lines, which is the phenomenon that we have to observe, amounts to the easily measurable quantity of twenty seconds of

There were known, indeed, variable stars of short period,

There were known, indeed, variable stars of short period, which it had been uggested might be explained on the hypothesis of a dark body recolving about a bright sen in a few days, but his theory was net by the objection that no such systems of the contraction of the star of the contraction of the

length star as it moved in its orbit alternately lowards and from our system, which would need for its detection the fiducial positions of terrestinal lines compared directly with them. For such observations the Potsdam spectrograph was well adapted. Prof. Vogel found that the highly star of Algol did adapted. Prof. Vogel found that the highly star of Algol did pulsate backwards and forwards in the visual direction in a period corresponding to the known variation of its light. The explanation which had been suggested for the star's variability, that it was partially eclipsed at regular intervals of 68 8 hours by a dark companion large enough to cut of nearly five sixths of its light, was therefore the true one. The dark companion, no longer able to hide uself by its obscureness, was brought out into the light of direct observation by means of its grayitational

Seventeen hours before minimum, Algol is receding at the rate of about 24½ miles a second, while seventeen hours after minimum it is found to be approaching with a peed of about 25½ miles. From these data, together with those of the varia-tion of vis light, Vogel found, on the assumption that both staffs have the same density, that the companion, nearly as large

as the sun, but with about one-fourth his mass, revolves with a velocity of about infly-te miles a second mile of the desired of of or second miles as the second miles of the complex of

that they are in different stages of coordensation, and unsatimating the stage of coordensation, and obscure companion as inclined to the line of sight, the companion will peak above or helow the bright star, and produce no variation of its light. Such systems may be numerous in the heavens. In Voget's photographs, Spica, which is not variable, by a small shifting of its lines reveals a backward and forward periodical. shifting of its lines reveals a backward and forward periodical pulsation due to orbital motion. As the pair whirl round their common centre of gravity, the bright star is sometimes ad-vancing, at others receding. They revolve in about four days, each star moving with a velocity of about fifty-ix miles a second in an orbit probably nearly circular, and possess a combined
mass of rather more than two and a half times that of the sun.

mass of rather more than two and a half times that of the sun. Taking the nous probable value for the star's parallax, the greatest angular separation of the star would be far too small to the star between the star that the star type, while the bright star is solar in character, the composite spectrum would be solar with the hydrogen libes unusually strong. Such a spectrum would miself afford some probability of a double orange, and suggest the existence of a composition of the star type, and suggest the existence of a composition of the star type of the star t

In the case of a true binary star the orbital motions of the air would reveal themselves in a small periodical swaying of

the hydrogen lines relatively to the solar ones.

Prof. Pickering considers that his photographs show ten stars Prob. Pickering considers that his photographs show the stars with composite spectra; of these, five are known to be double. The others are ~ Perset, f Aurige, 8 Sagittani, 31 Ceti, and 8 Capricorni. Perhaps \$ 1. yrc: should be added to this list. In his recent classical work on the rotation of the sun, Duncr.

has not only determined the solar rotation for the equator but for different parallels of latitude up to 75° The close accord ance of his results shows that these observations are sufficiently accurate to be discussed with the variation of the solar rotation for different latitudes which had been determined by the older astronomical methods from the observations of the solar spots.

Though I have already spoken incidentally of the invaluable and which is furnathed by photography in some of the applications of the apertoms of the apertoms of the apertoms of the apertom of the approximation of the approximati to this subject

to this subject.

The longraphy is no new discovery, lessing about half—century.

Photography is no new discovery, lessing about half—century processes and the processes are presented in about 10 miles and the spitch control of the spitch of the spitch to the spitch bodies dates from the memorable occasion when, in 1830, Arago, announcing Dageners, spoke of the possibility of taking pictures of the sun and moon by the new process, yet that it is only within a few parts that the spitch and the spitch is the spitch in the process of the sun and moon by the new process, yet that it is only within a few parts that the spitch advanced in autonomical methods and dis-

years that notable advances in autonomical methods and dis-covery have been mided by its and.

The explanation is to be found in the comparative manifolding.

The explanation is to be found in the comparative manifolding that the property of the propert

grained texture, meets the needs of the assistance. In our possesses extreme sensitiveness; it is always ready for use;

it can be placed in any position; it can be exposed for hours, lastly, it does not need immediate development, and for this reason can be exposed again to the same object on succeeding reason can be exposed again to the same objection succeeding nights, so as to make up by several instalments, as the weather may permit, the total time of exposure which is deemed

Without the assistance of photography, however greatly the resources of genius might overcome the optical and mechanical difficulties of constructing large telescopes, the astronomer would have to depend in the last resource upon his eye. Now we canhave to depend in the list resource upon his eye. Now we can-not by the force of continued looking hring into view an object of vision. But the feeblest light which falls upon the plate is not lost, but is taken in and stored up continuously. Each hour the plate gathers up 3600 times the light-energy which it received during the fair second. It is by this power of accumulation that curring the first second 11 is by this power of accumulation that the photographic plate may be said to increase, almost without limit, though not in separating power, the optical means at the disposal of the astronomer for the discovery or the observation of faint objects

of faint objects.

Two principal directions may be pointed out in which[photography is of great service to the astronomer. It enables him within the comparatively short time of a single exposure to secure permanently with great exactness the relative positions of hundreds or even of thousands of stars, or the minute features of numercus or even of thousands of stars, or the minute features of nebular or other objects, or the phenomena of a passing eclipse, a task which by means of the eye and hand could only be ac-complished, if done at all, after a very great expenditure of time and labour. Photography bats in the power of the attronomer complished, if done at all, after a very great expenditure of time and labour. Photography plats it in the power of the astronomer to accomplish in the short span of his own life, and so enter into their fruition, great works which otherwise must have been passed on by him as a heritage of labour to succeeding genera-

The second great service which photography renders is not simply an aid to the powers the astronomer already possesses. On the contrary, the plate, by recording light-waves which are both too small and too large to excite vision in the eye, brings him into a new region of knowledge, such as the infra-red and

nim into a new region of knowledge, such as the intra-red and the ultra-violet parts of the spectrum, which must have remained for ever unknown but for artificial help The present year will be memorable in astronomical history for the practical beginning of the Photographic Chait and Catalogue of the Heavens, which took their origin in an International Conference which met in Paris in 1887, by the invitation of M l'Amiral Mouchez, Director of the Paris Observatory

The richness in stars down to the ninth magnitude of the photographs of the comet of 1882 taken at the Cape Observatory photographs of the come to fi88s taken at the Cape Observatory under the superintendence of Dr Gill, and the remarkable star charts of the Brothers Henry which followed two years later, stomatics the astromatical was found. The great excellence of the star o Observatory has conducted the initial steps, through the many delicate and difficult questions which have unavoidably presented themselves in an undertaking which depends upon the harmonious working in common of many nationalities, and of no fewer than eighteen observatories in all parts of the world so lewer than eignteen onservatories in all parts of the world. The three years since 1887 have not been too long for the de-tailed organization of this work, which has called for several elaborate preliminary investigations on special point in which our knowledge was insufficient, and which have been ably earlied out by Profs Vogel and Bakhayara, Dr. Trepted, Dr. Scheiner, Dr. Gill, the Astronomer Koyal, and others: Time also was required for the construction of the new and special sow asser equired for the construction of the new and special. instruments.

instruments. The decisions of the Conference in their final form provide for the construction of a great photographic chart of the heavest with exposures corresponding to forly uninted: exposure at some construction of a great photographic chart of the heavest construction of the conference of the construction of the conference of the construction of the construction of the positions of the starts a release with lines at distances of 5 mm apartrius to be previously impressed by a faint light upon the plate, so that the

image of the rheats will appear together with the images of the stars when the plate is developed. This great work will be durised, according to their listuides, among eighteen observations proyided with aimitar instruments, though not necessarily con-structed by the same maker. Those in the Bruish dominious and at Tacubusy have been constructed by Srt Howard Grubb.

Besides the plates to form the great chart, a second set of plates for a catalogue is to be taken, with a shorter exposite, which will give stars to the eleventh magnitude only. These plates, by a recent decision of the Permanent Committee, are to be pushed on as actively as possible, though as far as may be practicable plates for the chart are to be taken concurrently. Photographing the plates for the catalogue is but the first step in this work, and only supplies the data for the claborate measurements which have to be made, which are, however, less laborious than would be required for a similar catalogue without the sid of photography.

Already Dr Gill has nearly brought to conclusion, with the

assistance of Prof Kaptevn, a preliminary photographic survey

of the southern heavens

of the southern heavers With an exporter sufficiently long for the fantiest stars to impress themselves upon the plate, the accoundating action still help the plate of the pl the affirmative, though at present the empirical formula which have been suggested for this purpose differ from each other Captain Abney proposes to measure the total photographic action, including density as well as size, by the obstruction which the stellar image offers to light.

A further question follows as to the relation which the photoaphic magnitudes of stars hear to those determined by eye graphic magnitudes of star's hear to those determined by eye Visual magnitudes are the physiological expression of the eye's integration of that part of the star's light which extends from the red to the blue. Photographic magnitudes represent the plate's integration of another part of the star's light—namely, from a little below where the power of the eye leaves off in the blue to where the light is cut off by the glass, or is greatly reduced by want of proper corrections when a refracting telescope is used. It is obvious that the two records are taken by different methods It is obvious that the two records are taken by district measures in dissipalar units of different parts of the star's light. In the case of certain coloured stars the photographic brightness is very different from the visual brightness; but in all stars, changes, different from the visual brightness; but in all stars, clianges, especially of a temporary character, may occur in the photographic or the visual region, unaccompanied by a similar change in the other part of the spectrum. For these reasons it would seem desirable that the two sets of magnitudes should be tabulated. lated independently, and be regarded as supplementary of each

The determination of the distances of the fixed stars from the The determination of the distances of the fixen same proofs in small apparent shift of their positions when viewed frost widely separated positions of the earth in its orbit is one of the most refuned operations of the observatory. The great precision with which this minute angular quantity—a fraction of a second only has to be measured, is so delicate an operation with the ordinary micrometer, though, indeed, it was with this instrument that the classical observations of Sir Robert Ball were made, that a special instrument, in which the measures are made by moving the two halves of a divided object-glass, known as a heliometer, has been pressed into this service, and quite recently, in the skilful hands of Dr. Gill and Dr. Elkin, has largely increased our knowledge in this direction.

It is obvious that photography might he here of great service, if we could rely upon measurements of photographs of the same stars taken at suitable intervals of time Prof. Pritchard, same same taken at suitable intervals of time. Fro, Frichard, to whom is due the honour of having opened this new path, asked by his assistants, has proved by elaborate investigations that measures for parallat may be safely made upon photographic plates, with, of course, the advantage of learner and repetition; and he has already by an assistant continuous control of the properties of t parallax for twenty-one stars with an accuracy not inferior to that of values previously obtained by purely astronomical

methods.

The regarkable successes of astronomical photography, which depend upon the plate's power of accumulation of a very feeble light esting continuously through an expoure of several hours, are worthy to be regarded as a new revelation. The first chapter

opened when, in 1880, Dr. Henry Draper obtained a picties of the netwis of Orion; but a more important advance was made in 1883, when Dr. Common, by his photographs, brought to our knowledge details and extensions of this nebula hisherto unknown. A further disclosure took place in 1885, when the submound of the common of the nebula hisherto unknown. A further disclosure took place in 1885, when the part of the property of the ened when, in 1880, Dr. Henry Draper obtained a picture great extension of the nebular region which surrounds the traper-rum in the constillation of Orion. By his photographs of the great nebula in Andromeda he has shown the true significance of the dark canals which had been seen by the eye. They are in reality spaces between successive rings of bright matter, which appeared nearly straight towing to the micration in which they lie relatively to us. There bright rings surround an unde-fined central luminous mass. I have a fready apoken of this

processing.

Some recent photographs by Mr. Russell show that the great rift in the Milky Way in Argus, which to the eye is rout of status, is in rentity uniformly covered with them. Also, quite recently, Mr. George Hale has photographed the prominences by means of a grating, making use of the lines H and K.

The heavens are richly but very irregularly inwrought with stars, the brighter stars cluster into well known groups upon a background formed of an enlacement of streams and convoluted windings and intertwined spirals of fainter stars, which becomes

windings and intertwined spirals of tailler stars, which becomes richer and more mirrated in the irregularly infed rose of the We, who form part of the emblaconty, can only see the design instorted and confused, here crowded, there scattered, at another place superposed. The groupings due to our position are mixed up with those which are real

are mixed up with those which are real

Can we suppose that each kummous point has no relation to

the others meet it than the seconductal sugglebourhouth of greater

the control of the control of the control of the control

the control of the control of the control of the control

the desert? Surely every star, from Sinus and Vega down to

each grain of the light-dut of the Milky Way, has its present

place in the heavenly pattern from the slow evolving of its past

and streams and spiral windings which mark the general design

and streams and spiral windings which mark the general design

and streams and spiral windings which mark the general design

and streams and spiral windings which mark the general design

and streams and spiral windings which mark the general design

control of the control of the whole is in motion, each

point shafting its position by miles every second, though from the

control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of the control of it is only by the accumulated movements of years or of genera-

inemselves.

The decipned is the wooderfully intracte constitution of the decipned is enderly intracte constitution of the wooderfully intracte constitution of works of the consequence of the primary task of the surfamonion in space, together with the motions of the brighter motion in space, together with the motions of the brighter surfamonion in space, together with the motions of the brighter surfamonion in the brighter surfamonion in the brighter surfamonion in the line of sight.

of sight.

From other directions information is accumulating: from photographs of clusters and parts of the Miliy Way, by Roberts in this country, Barmed as the Lief. Obervatory, and Raguell at in this country, Barmed as the Lief. Obervatory, and Raguell at configurations, by Holden and by Rackhouse; from the unsping of the Miliy Way by eye, at Paraoustoren, from photographs of the spectra of stars, by Pickering at Haward and in Fern; and from the exact portunitor of the beavens in the Tern and the Committee of the Stars, by Pickering at Haward and in Fern and the Committee of the Stars and the Committee of the

Rose on linar radiation, and the work on the same subject and on the tin, by Langley. Observations of linars heat with an of the warman of the moon's heat with line and the warman of the moon's heat with its phase by Mr. Frant. Very. The discovery of the ultra-voilet part of the hydrogen spectrum, not in the laboratory, but from the stars. The conspict of the property of the prop

series by Balmer. The important question as to the numerical spectral relationship of different substances, specially in connection to the origin of the harmonic and other relations between the lines and the groupings of lines of spectra; on these points contrabutions during the past year laws been made by Redol'r vintudions during the past year have been made by Redol'r vintudions, and the properties of the past year laws been made by Redol'r Vintudions of the spectra of the past year laws been past year. The remarks been proposed of the past year laws to the past year laws to the past year laws to the past year. The past year laws the past year laws to the past year laws to the past year. The past year laws to the past year laws to the past year laws to the past year. The past year laws to the past year laws to the past year laws to the past year. The past year laws to the past year laws to the past year laws to the past year. The past year laws to the past year laws to the past year laws to the past year. The past year laws to the past year laws to the past year laws to the past year. The past year laws to the past year laws to the past year laws to the past year. The past year laws to the past year laws to the past year laws to the past year. The past year laws to the past year laws to the past year laws to the past year. The past year laws to the past year laws to the past years to the past year. The past year laws to the past year laws to the past year laws to the past year. The past year laws to the past year laws to the past year laws to the past year. The past year laws to the past year laws to the past year laws to the past year. The past year laws to the past year laws to the past year. The past year laws to the past year laws to the past year laws to the past year. The past year laws to the past year laws to the year laws to the past year laws to the past year laws to the year laws to the past year. The past year laws to the past year laws to the past year laws to the year laws to the year laws to t subtend an angle less than that subtended by the light-wave at a distance equal to the diameter of the objective. A method applicable not alone to celestial objects, but also to spectral lines, and other questions of molecular physics.

Along the older lines there has not been less activity; by newer methods, by the aid of larger or more accurately con-structed instrument, by greater refinement of analysis, knowledge structed instruments, by greater refinement of analysis, knowledge has been increased, epectally in precusion and minute estancies. Astronomy, the olders of the scences, has more than renewed more than the scene of the scences, has more than renewed more than the scene of the s

Already, alas the original founders of the newer methods are

Already, alsa's the original founders of the newer methods are falling out-Knehoff. Angstrom, D'Arrent, Secchi, Draper, Becquierel, but their places are more than filled, the pase of the Section of the Section of the Section of Newton out knowledge of the phenomena of Nature has wonderfully increased, but man asks, perhaps more sameally now than in he days. What is the lutimate reality public of the beach with which we have been playing? Does not the ocean of ultimate reality and truth the beyond to the ocean of the section o

SECTION A

MATHEMATICS AND PHYSICS.

OPENING ADDRESS BY PROF OLIVER J. LODGE, D.Sc., LL D., F.R S., PRESIDENT OF THE SECTION

DURING the past year three or four events call for special mention in an annual deliverance of this kind by a physicist. One is the Faraday centenary, which was kept in a happy and One is the rarady centenary, which was kept in a happy and simple manner by a cosinopolitan gaihering in the place so long associated with his work, and by discourses calling attention to the modern development of discoveries made by him Another is the decease of the veteran Wilhelm Weber, one of

the originators of that absolute system of measurement which, though still ungrasped in its simplicity and completeness by the though still suggested in testing the support and comprehension by the majority of men engaged in practice, nor even, I fear, wholly understood by some of those engaged in University teaching, has yet done so much, and is destined to do (still more, for the unification of physical science, and for a thorough comprehension of its range and its limitations.

neation of physical science, and for a thorough comprehension.

A third event of importance during the year is the discovery in America of a binary system of stars, revolving round each other with grotscept hast, and with a promitty to each other such as to render their ordinary opical separation quite largost the stars of the property of the singular abstractly of the notion which was once property the singular abstractly of the notion which was once propounded by a philosopher, that motion of stars in our line of sight must for ever remain unknown to se; when the mere time for ever remain unknown to se; when the mere time of revolution of a stelline, compared with its distance from its mation on that head. As a matter of pedagogy it is mation on that head. As a matter of pedagogy it is mation on that head. As a matter of pedagogy it which is generally known to apply to the periodic disturbances concerned to the property of the principle called Doppler's which is generally known to apply to the periodic disturbances concerned to the property of the principle called the property of the

principle ¹ Any discrepancy between the observed and the calculated times of revolution of stars round each other can possibly
be explained by a relative motion between us and the pair of
bodies along the line of sight,
recognized thin, we should not so
the first committee conditions asserting that the apparent
time of revolution of a satellite of Justice depends on the distance of the earth from that planet, instead of on the speed I
should indeed be sorry to be judged by the performance of my
on students, but I few that many of the less obvious mistakes
made by reasonably trained examination candidates are more
directly irrecable to their teachers than some of us as teachers would like to admit.

The change in the refrangibility of light by reason of the motion of its source, though commonplace enough now, was at first regarded as too su all to be observed, and one or two attempts directed to detecting the effect of this principle on the specira of the stars, or sometimes on sunlight reflected by a 45° mirror into the line of the earth's motion (which is not a possible method), wholly failed 1 take pleasure in remembering that this effect was clearly observed for the first time by the gentleman we this year honour as our President, and that it is by this very means that the latest sensational discovery in astronomy of the rapidly revolving twin star & Autigut, by Prof Picker-ing and the staff connected with the Draper Mcmorral, was made

The funds for the investigation that led to this result were and if & Aurigo does not constitute a satisfactory memorial, I am at a loss to conceive the kind of tombstone which the relations of a man of science would prefer

The fourth event to which it behoves me to refer is the practical The fourth event to which it believes the discovery of a physical method for colour photography. When I say practical I do not mean commercial, nor do I know that it I say practical I do not mean commercian, no do a most supplicable to the ordinary business of the photographer Whether it does or not, it is a sound achievephotographer Whether it does or not, it is a sound achieve-ment by physical means of a result which the chemical means ment by physical means of a result which the chemical means hitherto tred failed, some think necessarily failed, to produce I asy practical, because already it had been suggested as possible theoretically; and a step toward it, indeed very near it, had been actually made The first suggestion of the method, so far as I know, as made by Lord Rayleigh in the course of a matheniancial paper on the reflection of light, and with reference to some results of Beenjured obtained on a totally different plan. He said in a note that if by normal reflection waves of light were converted into stationary waves, they could shake out silver in siraia half a wave length apart, and that such strata would give selective reflection and show iridescence.

The colour of certain crystals of chlorate of potash, described in a precise manner by Sir George Stokes (Proc Roy Soc., February 1885), and also the colours of opal and ancient glass, returns 1989), and no the colours of opat and ancient glass, and been elaborately and completely explained by Lord Rayleigh ou this theory of a periodic structure (the laminated structure in the case of chlorate of potash being caused by twinning) (Fh.I.) Mag., September 1888, pp. 256 and 241), and he subsequently illustrated it with sound and a series of mushin disks one behind the ratest it with sounds and a series of musin disks one behind the other on as eto I say-tongs. Each membrane reflected an inappreciable amount, but successive equitistant membranes reinforced each other's action, and the entire set reflected distinctly one definite note, of wave-length twice the distance between adjacent muslim. So also with any series of equalistant strata each very slightly reflecting. They should give selective reflection, and the spectrum of their reflected beam should show a single line or narrow band, corresponding to a wave length twice the distance of the strata apart.

twee the distance of the strain apart.*

1) P. Huggma has polymlos ofto one a spriferly clear statement to the strain of the str

Independently of all this, Herr Otto Wiener, imitsting Hertz's experimenta with ordinary light, in 1889 reflected a beam directly back on itself, and, by interposing a very thin collodion film at extraordinarily oblique incidence, succeeded in the difficult experiment of so magnifying by the cosine of inclination the half wave length, as to get the silver deposited in strata of visible width, and thus to photograph the interference nodes themselves at the places where they were cut by the plane of the film (Wiedemann's Annalen, vol xl , 1890)

Then M. Lippmann, using a thicker film, not put obliquely but normal to the light, obtained the strata within the thickness of the film stself—hundreds of tayers, and so, employing incidence light of definite wave-length, was able to produce a stratified deposit, which reflected back at appropriate incidences the same wave-length as produced it , thus reproducing, of course, the definite colour

It is probable that the silver is first shaken out at the ventral segments, but that the strain so formed are thick and blurry. segments, but that the sirans so formed are thick and blurry. I competure that by over expourer this deposit is nearly all mopped up again, traces being left only at the noises, where the action is very feelbe and takes a long time to occur. but that these resultainstrain, heing fairly sharp and definite, will be likely to give much better-fletcs. And so I suppose that these are what are actually effective in obtaining M. Lippinian's very interesting, though not yet practically useful, results.

I now leave the retrospect of what has been done, although many other topics mucht usefully detain us, and I proceed to glance forward at the progress shead and at the means we have

giance forward at the progress anead and at the means we have for effectively grappling with our due share of it. There is a subject which has long been in my mind, and which I determined to bring forward whenever I had a cathedral opportunity of doing so, and now, if ever, is a sintable occasion It is to call attention to the fact that the further progress of physical science in the somewhat haphazard and amateur fashion in which it has been hitherto pursued in this country is becoming increasingly difficult, and that the quantitative portion especially increasingly difficult, and that the quantitative portion especially should be undertaken in a permanent and publicly supported physical laboratory on a large scale. If such an establishment were to weaken the sinews of private enterprise and individual research it should be strenously opposed; hut, in my opinion, it would have the opposite effect, by relieving the private worker of much which he can only with great difficulty, sacrifice, and expense, undertake. To illustrate more precisely what I mean, expense, undertake. To illustrate more precu The amateur asit is sufficient to recall the case of astronomy. The amateur as-tronomer has much work lying ready to the hand, and heg graphes with it manfully. To him is left the striking out of new lines and the guerila warfare of science. Skirmishing and brilliant carely) evolutions are his battural field, he should not be called upon to take part in the general infantry advance. It is wasting energies, and he could not do it in the long run well. Wi energies, and he could not do it in the long run well. What, for instance, would have been the state of astronometry—the nautical almanac department of astronomy—without the consecutive and systematic work of the National Observatory at Greenwish? It may be that some enthusiastic amateurs would have devoted their lives to this routine kind of work, and here at one time and there at another a series of accurate observations would live been kept for several years. Pur ued in that way, however, not only would the effort be spaamodic and temporary, nowever, not only would the effort be spaamodic and temporary, but the energy and enthusians of those amateurs would have been diverted from the pioneering more suited to them, and have heen cramped in the groove of routine, emineatly adapted to a permanent official staff, but not wholesome for an individual

Long continued consecutive observations may be made by a leader of science, as functions may be tabulated by an eminent mathematician, but if the work can be done almost equally well (some would say better) by a professional observer or com-

putator, how great an economy results

parties, and we great take compily to subpute. The ohm has been determined with a figure, perhaps with 5 figure, accuracy, thinks of the list of emment men to whose severe personal laborative ow this result, and ask if the spoil is worth the cost. Perhaps in this case it st, as a speemen of a well conducted determination. We must have a few speemens, and our leaders determination. We must have a few specimens, and our leaders must show as the way to do things. But let us not continue to use them for such purposes much longer. The quest of the fifth or sath declimal is a very legiturate, and may secome a very absorbug, quest, but there are plenty of the rank and file who can undertake it if properly generalled and led not as soluted individuals, but as workers in a National Laboratory under a competent head and a governing committee. By this means work far greater in quantity, and in the long run more exact in quality, can be turned out, by patient and conscientions thoour without much genus, by the gradual improvement of instrumental means, by the skill acquired by practice, and by the steady drudgery of routine. Paris has long had one form of such an institution, in the Conservatore de Afris et Métlers, and has been able to imthe Conservators east Arts et occuers, and nas need no see to impose the metric system on the civilined would in consequence, the first of just such a system. Berlin is now starting a similar or a more ambituous scheme for a permanent national physical institute. Is it not time that England, who in physical selence, I wenture to think, may in some sort claim a leading place,

I venture to think, may in some sort claim a reasing piace, should be thinking of starting the same movement?

The Meteorological and Magnetic Observatory at Kew (in the nauguration of which this Association took so large a part) is a step, and much useful quantitative work is done there. The new Relectine Standardising Laboratory of the Board of Trade is another and, in some respects perhaps, a still closer appproxi-mation to the kind of thing I advocate But what I want to see is a much larger establishment erected on the most suitable site. limited by no speciality of aim nor by the demands of the commer cial world, furnished with all appropriate appliances to be amended and added to as time goes on and experience grows, and invested with all the dignity and permanence of a national institution a with all the dignity and permanence of a national institution a Physical Observatory, in fact, percessly comparable to the Green-with the review of the control of the co in electrical matters already attained. The work and appliances of the mechanical engineer eclipse the present achievements of the physicist in point of accuracy, and it is by the aid of the mechanical and opticisal that precision even in astronomy has reached so high a stage. There is no reason why physical determinations should be conducted in an amateur fashion, it the committee of the property of the proper paratively imperfect instruments, as at pre-ent they mortly are Discoveries lie along the path of extreme accuracy, and they will turn up in the most unexpected way

The aberration of light would not have been discovered had not Bradley heen able to measure to less than 1 part in 10,000, and what a brilliant and momentous discovery it was! He was aiming at the detection of stellar parallax, but the finite velocity of light was a bigger discovery than any parallax This is the type of result which sometimes lurks in the fifth decimal, and which confers upon it an importance beside which the demands of nich who wish to serve the tasto and the pocket of the British public sink into insignificance
In a National Observatory accuracy should be the one great

end: the utmost accuracy in every determination that is decided end: the utmost accuracy in every determination that is decided on and made. Only one thing should be more thought of than the fifth againscant figure, and that is the sixth. The con-sequences flowing from the results may safely be left; such as are not obvious at once will distil themselves out in time. And are not obvious at once will distil themselves out in time. And the great army of outside physicists, assured of the good work being done at headquarters, will (to speak again is astronomical parable) cease from peddling with taking transits or altitudes, and will be free to discover comets, to invent the spectroscope, to watch solar phenomena, to chemically analyse the stars, to devise celestial photography, and to elaborate still more celestial theories, all of which novelties in their maturity may be handed over to the National Observatory, to be henceforth incorporated with, and made part of, its routine life; leaving the advance guard and skirmishers free to explore fresh territory, poracte with, and made part of, its routine life; leaving the an-vance guard and skirnishers free to explore fresh territory, secure in the knowledge that what they have acquired will be properly surveyed, mapped, and utilised, without further atten-tion from them. At to the practical applications, they shay any case he left to take care of themselves. The institute of humanity in this direction, and the so called solid gains associated with practical achievements, will always secure a sufficient number of acute and energetic workers to turn the new territory number of acute and energetic workers to turn the new territory mot arable land and pasture displeted to the demands of the most acute land and pasture displeted to the demands of the fettile is, of course, heyond pritter; but it is not the work of the ponner. As Mr. Husky eloquently put it, when contrasting the application of science with the advanced of the supplementation of the suppl craftsmen. But even while the cries of jubilation resound, and this flotsam and jetsam of the tide of investigation is being turned into the wages of workmen and the wealth of capitalists. the crest of the wave of scientific investigation is far away on its course over the illimitable ocean of the unknown."

I have spoken of the work of the National Laboratory i devoted to accuracy. It is hardly necessary to say that it will be also the natural custodian of our standards, in a state fit for use and for comparison with copies sent to be certified. Else perhaps some day our standard ohm may be buried in a brick wall at Westminster, and no one living may be able to recall precisely where it is,

But, in addition to these main functions, there is another. equally important with them, to which I must briefly refer.
There are many experiments which cannot possibly be conducted Inere are many experiments which cannot possibly be conducted by an individual, because forty or fifty years is not long enough for them. Secular experiments on the properties of materials— the elasticity of metals, for instance, the effect of time on mole-cular arrangement; it is influence of long exposure to light, or to

heat, or to mechanical vibration, or to other physical agents

Does the permeability of soft fron decay with age, by reason
of the gradual cessation of its Amperian currents? Do gases of the gradual cessation of its Ampirana currents? Do guess cool themselves when adiabalically preserved, by reaso on immediate when adiabalically preserved, by reaso on immediate the season of the

a national laboratory, with permanent traditions and a con-tinuous life, is undoubtedly the only appropriate place. At such a place as Glasgow the exceptional magnitude of a present occupant may indeed inspire sufficient piety in a successor to secure the continuance of what has been there begun, but in secure the continuance or what has been there began, and in most college laboratories, under conditions of migration, in-terregnum, and a new rigime, continuity of investigation is hopeless.

I have at any rate said enough to indicate the kind of work

for which the establishment of a well-furnished laboratory with fully equipped staff is desirable, and I do not think that we, as a nation, shall be taking our proper share of the highest scientific work of the world until such an institution is started on its

There is only one evil which, so far as I can see, is to be feared from it if ever it were allowed to impose on outside workers as a central authority, from which infallible dicta were issued, it would be an evil so great that no amount of good work carried on by it could be pleaded as sufficient mitiga-

tion If ever by evil chance such an attitude were attempted, it If ever by evil chance such an attitude were attempted, it must rest with the workers of the future to see that they permit no such shackles; for if they are not competent to be independent, and to conteaun the vace of authority speaking as mere authority, if their only safeguard hes in the absence of necessity for struggle and effort, they cannot long hope to escape from the futility which surely awaits them in other directions.

I am thus led to take a wider range, and, leaving temporary and special considerations, to speak of a topic which is as yebyond the pale of scientific orthodox, and which I might, more wisely, leave lying by the roadwide. I will, however, take the rask of introducing a rather ill favoured and disreputable looking stranger to your consideration, in the belief-I might say, in the assured conviction—that he is not all scamp, and that his present condition is as much due to our long-continued neglect

as to any inherent incapacity for improvement in the subject.

I wish, however, strenuously to guard against its being supposed that this Association, in its corporate capacity, lends its posed that this Association, in its corporate capacity, itemas-incountenance to, or looks with any favour on, the outcast. What I have to say—and after all, it will not be much—must rest on yown responsibility. I should be very sorry for any adventitious weight to attach to my observations on forbidden topics from the accident of their being delivered from this fails. The from the accident of their being delivered from this chair. The objection at which I have now hinted is the only one that seems objection at which I have now hinted it the only one first stems to the read by six weight, and on all other counts I am willing to mear such amount of opprobrium as naturally stuckles to those who enter on a region where the first of controversy are not extract, and in which it is quite impossible, as well as undesarble, for everyone to think alika. But the control of the contr

should ever be allowed to obtrude itself before us Our ancestors should ever be allowed to obtrude itself before us. Our ancestors togeth hard and suffered amon for the privilege of free and open inquiry, for the right of conducting investigation untransmelled reasons and the property of the conducting investigation untransmelled and the conducting the c mediately adjacent thereto, were to end in our losing the power of raining our year and recovering evidence of a totally fresh processes of the processes of the processes of mounty as each evidence of regions into which the support of the processes of mounty as each evidence of the processes of

For instance, there is the question whether it has or has not been established by direct experiment that a method of communication exists between mind and mind irrespective of the ordinary and, if so, what is the process It can hardly be through some unknown sense organ, but it may be by some direct phycon- unknown lean-regard, but may be by some direct physical indicates on may be by some direct physical indicates on the page of the may be by some direct physical indicates on the page of the page

the recognized scientific societies who would receive a paper on the subject 1. There are individual scientific men who bave

investigated these matters for themselves ; there are others who are willing to receive evidence, who hold their minds open and their judgment in suspense, but these are only individuals. The great majority, I think I am right in saying, feel active hostility to these recearches and a determined opposition to the reception or discussion of evidence. And they feel this confirmed

scepticem, as they call it, not after prolonged investigation, for then it might be justified, but sometimes after no investigation of at all. A few tricks at a public performance, or the artifices of tome impostor, and they decline to consider the matter further That individuals should take this line is, however, natural enough ; they may be otherwise occupied and interested

body is by no means bound to investigate everything, though, indeed, it is customary in most fields of knowledge for those who have kept aloof from a particular inquiry to deter in moderation to those who have conducted it, without feeling themselves called upon to express an opinion. Some there are, no doubt, who cognider that they have given sufficient time said attention to the subject with only negative results. Their evidence is, of course, morportant; but plantly, negative evidence should be of immense bulk and weight before it can outweigh even a moderate amount have kept aloof from a particular inquiry to defer in moderation to bulk and weight before it can outweigh even a monerate amount of positive evidence. However, it is not of the action of individuals that I wish to speak, it is of the attitude to be adopted by scientific bodies in their corporate capacity, and for a corporate body of men of science, inheritors of the hard-won tradition of free and fearless inquiry into the facts of nature tradition of free and fearless inquiry into the facts of nature untrammelled by prejudec, for any such body to decline to receive evidence laborously attained and discreetly and in-offensively presented by observer of accepted competency in other branches, would be, if erer actually done and persisted in, a terrible throwing away of their perogative, and an instation of the errors of a school of thought against which the struggle was at one time severe.

struggle was at one time server.

In the early days of the Copernican theory, Gahleo for some years reframed from teaching it, though fully believing its truth, because he considered that he had better get more fully settled in his University chair before evoking the storm of controversy which the abandonment of the Tolemaic system would arouse. The same thang in very more degrees is going on to day. Then the control is not the same thang in very more degrees in these new laveringstons of men who behalts to a vow introcts in these new laveringstons.

1 This, however, is mere conjecture I am not aware that the experiment

NO. 1138, VOL. 447

(I do not mean eredence—the time is too early for avowing tained facts—but hesitate to avow interest) until they have settled tained facts—but nestitate to avow interest) until mey nave setuted down more securely and made a name for themselves in other lines. Caution and slow progress are extremely necessary; fear of avowing interest or of examining into unorthodox facts is, I venture to say, not in accordance with the highest traditions of

the scientific attitude

the scendific attitude.

We are, I supposed of once extent afraid of each other, but
We are, I supposed of once the state of each other, but
the opinions of our elders and superiors, we find the opinions of our elders and superiors, we find the opinions of our elders and superiors, we find the opinions of our other, so we are silent. We have, moreover, a righteous mastruis of our own powers and knowledge, we perceive that it is a winder region extending into everal already cultivated that it is a wise region extensing into several arready cuturwater branches of science, that a many-sided and highly trained mind is necessary adequately to cope with all its ramifications, that in the absence of strict inquiry impositure bas been rampent in some portions of it for centuries, and that unless we are pre-terraturally careful we may get led into quaginites if we venture on it at all

on at airli

Now let me be more definite, and try to state what this field
is, the exploration of which is regarded as so dangerous I

Now let me to the state of the state of the state of the state
and the state of the state o and medicine. An occasional psychologisi has groped down and into it and become a metaphysician. An occasional physicist has wandered up into it and lost his base, to the horror of his quondam brethren. Biologists mostly look at it askance, or deny its existence. A few medical practicumers, after long maintenance of a miniar attitude, have begun to annex a portion of its western frontier. The whole region seems to be inhabited mainly by savages, many of them, so far seems to be inhibited mainly by awages, many of them, "of as we can page from a distance, given to gross supersistion. It may, for all I know, have been hastly traversed, and radely continued to the control of the co

writings may, when interpreted, mean much But to us, as physicists, they are unsatisfactory, their methods are not our methods. They may be said to have floated a balloon over the physiciss, my my may be said to have floated a balloon over use received in the phase caught received and fragments glass statehed, in which they have caught received and fragments glass to the phase per part of the phas

iar more than they saw
Our method is different
We prefer to creep slowly from our
base of physical knowledge, to engineer carefully as we go,
exhibiting fors, making roads, and thoroughly exploring the
country; making a progress very slow, but very lasting. The
psychologists from their side may meet us. I hope they will,
but one or other of us ought to begin.

but one or other of us ought to begin.

A valuerable spot on our side seems to be the connection between life and energy. The conservation of energy has been so long established as to have become a commonplece. The relation of life to energy is not understood. Life is not energy, and the death of an animal affects the amount of energy no whit, yet a live animal exerts control over energy which a dead one a live animal exerts control over energy which a dead one cannot Life it a guiding or directing principle, disturbing to the physical work but not yet given a place in the scheme performance of work; the guidine of energy needs no work, but demands force only. What is force? and how work but demands force only. What is force? and how worked by the demands force only when the force of the material control of the control of the control of the material control of the control of the control of the material control of the control of the control of the material control of the control of the control of the material control of the contr worked by preceding conditions—that is, soy the past—my un-materizable. After we so user that they are not worked by the feature too? In other words, that the totality of things, by where the sax well as the past, and that to attempt to deduce those actions from the past only will prove impossible. In some way matter can be moved, guided, disturbed, by the segancy of ling beings; is is some way there is a control, a directing-agency active, and remains are tassed at its choice and will that would not otherwise happen.

* The expression "controlled by the future" I first heard in a conversation with G. F. Fetagerald, who seemed to consider it applicable to all avents, without exception

A luminous and helpful idea is that time is but a relative mode of regarding things, we progress through phenomena at a certain defin to pace, and this subjective advance we interpret in an stenn to pace, and this subjective advance we interpret in an objective manner, as if events necessarily happened in this order and at this precise rate. But that may be only one mode of regarding them. The events may be in some sense existent always, both past and future, and it may be we who are arriving atways, both past and future, and it may be we who are arriving at them, not they which are happening. The analogy of a traveller in a rativacy train is useful. If he could never leave the train nor after its pace, he would probably consider the landscapes as necessarily successive, and be madde to conceive their co existence

The analogy of a solid cut into sections is closer The analogy of a solid cut into sections is closer We recognise the universe in sections, and each section we call the present. It is like the string of slices cut by a microtome, it is our way of studying the whole. But we may err in supposing that the body only exists in the slices which pass before our microscope

in regular order and succession.

We perceive, therefore, a possible fourth dimen-lonal aspect about time, the inexorableness of whose flow may be a natural part of our present limitations. And if once we grasp the idea that past and future may be actually existing, we can recognise that they may have a controlling influence on all present action, and the two together may constitute "the higher plane," or the totality of things, after which, as it seems to me, we are impelled to seek, in connection with the directing of force or determinism, and the action of living beings consciously directed to a definite

and preconceived end.

186

Inanimate matter is controlled by the vis a lergo, it is operated on solely by the past. Given certain conditions, and the effect in due time follows. Attempts have been made to the effect in due time follows. Attempts have been made apply the same principle to living and conscious beings, but without much succe s. These seem to work for an object, even if it be the mere seeking for food; they are controlled by the idea of something not yet palpable. Given certain conditions, and the section control are successful than the section of the conditions are the section of and their action cannot certainly be predicted; they have a sense of option and free will Either their actions are really arbitrary of option and free will Either their actions are really arbitary and indeterminate—which is lightly improbable—or they are controlled by the figture as well as by the pisa! Inagine bongs they will be invogrationate, and will eithbit all the characteristics of live creatures. Moreover, if they have a meterly expensionate and the characteristics of live creatures. Moreover, if they have a meterly expensionate havoring, necessarily intended by memory and bounded by the past, they will be unable to predict each under's actions with any creaturally, because the whole of the datas are not before the control of the control of the control to the control of the contr them May not a clearer apprehension of the meaning of life and will and determinism be gradually reached in some such direction as this?

By what means is force exerted, and what, definitely, is my what means is force exerted, and what, definitely, is force? I can lardly put the question here and now so as to be intelligible, except to those who have approached and thought over the same disculties, but I venture to say that there is here something not provided for in the orthodox scheme of physics, that modern physics is not complete, and that a line of possible advance her in this direction.

I might go further Given that force can be exerted by an act of will, do we understand the mechanism by which this is done? And if there is a gap in our knowledge between the conscious idea of a motion and the liberation of muscular energy needed to accommotion and the liberation of mutualar energy needed to accom-plifit, in low one know that is bodying up to the more dwinfout that such a thing is possible. I have tired once or twee to ob-serve its asserted occurrence, and failed to get anything that satisfied me. Others may have been above fortunate. In any decay the possibility. If the conservation of centry were upset by the process, we should have grounds for denying it. I such that the contract of the contract of a novel of a novel nobling that we know it speet by the discovery of a novel modium of communication, perhaps some more immediate action medium of the communication perhaps some more immediate action cline to examine phenomena because we feel too stare of their moustability. We ought to know the universe very thoroughly and completely before we take up that attracts and outside the perhaps that the perhaps the perhaps

This 14, of course, not assertion, but suggestion. It may be error to draw any such distinction between ammate and intermale

writing, or in other ways. A prearranged code called language, and a material medium of communication, are the recognised methods. May there not also be an immaterial (perhaps an ethereal) medium of communication? Is to possible that an idea can be transferred from one person to possible that an idea can be transferred from one person to another by a process such as we have not yet grown accustomed to, and know practically nothing about? In this case I have evidence I assert that I have seen it done, and am perfectly convinced of the fact. Many others are satisfied of the truth of it too. Why must we speak of it with bated breath, as of a thing, of which we are sishamed? What right have we to be ashamed of a truth?

ashamed of a truth?
And after all, when we have grown accustomed to it, it will not seem slogether strange. It is, perhaps, a natural consequence of the community of life of family relationship raining through all living beings. The transmission of slightening through all living beings. The transmission of slightening through all living beings, the transmission of slightening and all magnets are sympathetically coinceted, to this if voirably are perioded arterization from our disturbs others, even though they

be distant ninety-two million miles

It is sometimes objected that, granting thought-transference or telepathy to be a fact, it belongs more especially to lower forms of life, and that as the cerebral hemispheres develop we become independent of it, that what we notice is the relic of a decaying faculty, not the germ of a new and fruitful sense; and that progress is not to be made by studying or attending to it.

It may be that it is an immature mode of communication, adapted It may be that it is an immature mode of communication, anapter to lower stages of consciousness than onrs, but how much can we not learn by studying immature stages? As well might the objection be urged against a study of enhypology I may, on the other hand, be an indication of a higher mode of communi-cation, which shall survive our temporary connection with ordinary matter

I have spoken of the apparently direct action of mind on mind, and of a possible action of mind on matter. But the whole region is unexplored territory, and it is conceivable that matter may react on mind in a way we can at present only fimly imagine In fact, the barrier between the two may gradually melt away, as so many other harriers have done, and we may end in a wider perception of the unity of nature, such as

cou in a winer perception of the unity of nature, such as philosophers have already dreamt of. I care not what the end may be shall be conducted by us, and that we shall be free from the diagrace of jogging along accustomed roads, leaving to outsiders the work, the ndicule, and the grantification, of unfolding

a new region to unwilling eyes

a new region to unwilling eyes
It may be held that such investigations are not physical and
do not concern as. We cannot tell without pring. In that I
do not concern as a physicasts. It may concern other
which does concern us as physicasts. It may concern other
sciences too. It must, one would suppose, some day concern
biology, but with hat I have nothing to do. Bhologusts have
their region, we have ours, and there is no need for us to hang
hack from an investigation because they do. Our own steenes, of Physics or Natural Philosophy in its widest sense, is the King of the Sciences, and it is for us to lead, not to follow

And I say, have faith in the Intelligibility of the universe Intelligibility has been the great creed in the strength of which all intellectual advance has been attempted, and all scientific

progress made.

At first things always look mysterious. A comet, lightning, the At first things always look mysterious. A comet, lightning, the autora, the rainbow—all strange anomalous mysterious appartions. But scrutinized in the dry light of science, their relationship with other better-known things becomes apparent. They cease to be anomalous; and though a certain mystery

necessarily remains, it is no more a property peculiar to them, it is shared by the commonest objects of daily life. The operations of a chemist, again, if conducted in a hap-hazard manner, would be an indescribable medley of efferves a concentration of the chemist, again, if conducted in a hap-hazard manner, would be an indescribable medley of efferves. ansatz manner, would be an indescribate medicy of energe-cences, precipitations, changes in colour and in substance; but, guided by a thread of theory running through them the processes fall into a series, they all become fairly intelligible, and any explosion or catastrophe that may occur is capable of explanation

Now I say that the doctrine of ultimate intelligibility should Now I say that the doctrine of ultimate intestigating since be pressed into other departments also At present we hang back from whole regions of inquiry, and say they are not for us. A few we are beginning to grapple with. The nature of disea e is yielding to scrutup with fruitful result; the mental aberrations and abnormalisties of hypotolism, duplex personality, and allited phenomena, are now at last being taken under the wing of science after long riducile and contempt. The phenomenon of crime, the scientific meaning and justification of altrulam, and other matters relating to life and conduct, are beginning, or perhaps are barely yet beginning, to show a vulnerable from

pernaps are narely yet beginning, to show a vulnerable from over which the forces of science may pour Facts to airsinge that they have been called miraculous are now no longer regarded as entirely incredible. All occurrences seem reasonable when contemplated from the right point of view, and some are believed in which in their essence are still quite marvellous. Apply warmth for a given period to a sparrow's egg, and what result could be more incredible or magical if now discovered for the first time. The possibilities of the universe are as infinite as is its physical extent. Why

of the universe are as immire as a large should be grope with our eject always downward, and deny the possibility of everyining out of our accustomed best. If there is a puzzle about free will, let it be attacked, puzzles mean a state of half knowledge, by the lime we can grant something more approximating to the totality of things, the paradoxity of paradoxes drops away and becomes unrecognizable I seem to myself to catch glimpses of clues to many of these old questions, and I urge that we should trust consciousness, which has led us thus far, should shrink from no problem when the time seems ripe for an attack upon 11, and should not hestate to press investigation, and agcertain the laws of even the most recondite problems of life and mind

recondite problems of life and mind.

What we know is as nobling to that which remains to be known. This is sometimes said as a trusm, sometimes it is half doubted. To me it seems the most literal truth, and that if we narrow our view to already half conquered territory only, we shall he false to the men who won our freedom, and treason-

able to the highest claims of science
I must now return to the work of this Section, from which I have apparently wandered rather far afield, further than is customary—perhaps further than is descrable. But I hold that occssionally a wide outlook is wholesome, and that without such occasional survey, the rigid attention to detail and minute scrutiny of every little fact, which are so entirely admirable and are to rightly here fostered, are apt to become unhealthily dull and monotonous. Our life works is concerned with the rigid framework of facts, the skeleton or outline map of the universe tramework of facts, the sketeton or outline map of the universe and, though it is well for us occasionally to remember that the texture and colour and beauty which we habitually ignore are not therefore in the slightest degree non-existent, yet it is safest speedily to return to our base and continue the slow and laboraous march with which we are familiar and which experience has instified justified It is because I magine that such systematic advance is now beginning to be possible in a fresh and unexpected direction that I have attempted to direct your attention to a subject which, if my prognostications are correct, may turn out to be one of special and peculiar interest to humanity

THE LATE PROF. MARTIN DUNCAN, F.R.S. X/E have already announced the death of this wellknown geologist, and now give a brief account of his services to science.

As a Fellow of the Royal, Linnean, Geological, and Microscopical Societies, and for some time President of the two last-named of these, it goes without saying that his attainments were of no mean order. Educated for the medical profession at King's College, London, he matriculated at the London University in 1841, taking honours in anatomy and physiology in 1844, and the degree of Bachelor of Medicine in 1846, in which year also he qualified as a Member of the Royal College of Surgeons His early life was passed at Rochester with Dr. Martin, and at Colchester, where he was in practice for some years, and where he so won the esteem of all who knew him that he was elected Mayor of that city Fascinated with the study of geology, and impressed with the idea that to make any mark in the scientific world a man should take up some spécialite, he not only obtained a broad grasp of his favourite subject, but devoted himself especially to a study of fossil corals and echinoderms, on which subjects at intervals he published numerous valuable memoirs Indeed, for many years, and up to

within a comparatively short period of his death, he conwithin a comparatively stori period of instealin, he con-tinued to work at his sperial subject, and contributed many important papers to the Annals and Magazine of Autural History, the Journal of the Geological Society, the Geological Magazine, Quarterly Journal of Micro-sophical Science, the Philosophical Transactions and Proceedings of the Royal Society, the Proceedings and Transactions of the Zoological Society, and the Journal of the Linnean Society

He soon found that residence out of London, away from scientific societies and important works of reference. was a great obstacle to work, and that if he was to make any real progress with his special studies it was absolutely necessary for him to seek some appointment in the metro-polis Portunately for him, as it happened, the Chair of Gology at King's College became vacant, and he was appointed to fill it. This at once gave him the oppor-tunity he had so long hoped for, and the preparation of his lectures proceeded side by side with much useful work, which, by degrees, he found time to publish. Such, for example, was his account of the Madreporaria collected during the expedition of H M S Poscupine, which appeared in the Transactions of the Zoological Society (Part 1, vol viii p 303, &c, and Part 2, vol x p 235, &c), his description of deep-sea and litoral corals from the Atlantic and Indian Oceans (Proc Zool Soc, 1876, p. 428, &c); and his important revision of the Echinoidea, printed in the Journal of the Linnean Society, of which it occupied four numbers

This was all strictly scientific work, but by no means represented all that he accomplished. As a popular exponent of the teaching of geology and zoology, especially in regard to the lower forms of life, he published many excellent articles which were designed to awaken an interest in subjects little investigated, though well worthy of attention.

Lucidly written and full of facts, these articles were at once instructive and suggestive, and from a teachers' point of view did more to educate youthful naturalists and encourage research than any of his more scientific papers, which, being of a more technical character, were less acceptable to the majority of readers because less intelligible to them

Of this class were his articles on "Corals and their Polypes" (Intellectual Observer, 1869, pp 81-91, 241-50, with two coloured plates), "Studies amongst Ameche" (Popular Science Review, 1877, with two plates), and "Notes on the Ophiurans, or the Sand and Brittle Stars"

(Popular Science Review, 1878, with a plate)
lits attention, however, was not confined to invertebrate 200logy or geology. In 1878 he commenced the publication, in six volumes quarto, of a popular " Natural History," which had the ment of being written by a number of able specialists upon a comprehensive plan under his direction, and, while taking upon himself the laborious duties of editor-in-chief, he contributed many of the sections himself Thus, while securing the cooperation of such well-known zoologists as the late Prof. W. K. Parker, the late Mr. Dallas, Prof Seeley, Prof. Boyd Dawkins, Dr. H. Woodward, Dr. Murie, Mr. H. W. Bates, and Mr. R. B. Sharpe, he himself undertook the preparation of the articles on Apes and Monkeys, Lemuis (part), Edentata, Marsupialia, Reptilia, and Amphibia He also wrote the introduction to the Invertebrata, and the articles Vermes, Zoophytes, and Infusoria which appeared in the last volume, published in 1883.

For an excellent summary of marine zoology, in which the appearance, structure, and habits of such animals the appearance, structure, and mabits of such animals and plants as may be found upon our coasts are well described, the reader may be referred to a little volume by Dr Duncan, entitled "The Sea shore" It forms one of a series of "Natual History Rambles," issued a few years since by the Society for Promoting Christian Knowledge, ard, for the amount of information which it contains, as well as for its lucid expression, deserves to be better known

Dr. Marin. Duncan was undoubtedly one of the working bees in the great hive of science; and in his own quiet, unostentations way has stored up a considerable amount of material the value of which will be more and more appreciated as those for whose benefit it was accumulated come to examine and understand it.

In his ardent devotion to science, and patient industry in spite of trials and troubles which would have deterred many less earnest workers, he set a bright example, which those of a younger generation of naturalists would do well to follow

NOTES

IT seems that those members of the Government, whichever they may be, who are responsible for buildings for scences and art, have determined to even new galleries for the Art Museum at South Kennington, practically to cover all the ground which is supposed to be applicable for art purposes there. These buildings are to cost some £40,000, and, when this moving it a special to the suppose the South Kennington Art Museum will be finished by the suppose, also, that the building of a Science Museum will by this action, be delayed for another twenty years. This will be a great victory for art, and will afford another interesting example of the results of the way in which matters scientific are managed in this country.

Ms. EDAN. TRUNKTON, Curator of the Government Museum at Madras, has been appointed to officiate for two years for Dr. Watt, at Calcutta, in reporting on economic products and organizing collections of products and manufactures for the Calcutta and other Indian Museums, in dutte at Madras being in the meantime discharged by Dr. Warth, of the Geological Department.

PROF GOEBEL, of Marburg, has been appointed to the Chair of Botany at Munich in succession to the late Prof Naegeli.

WE regret to announce the death of Dr. Weiss, the Professor of Botany and Director of the Plant Physiological Institute of the University of Prague

THE late Cardinal Haynald's important herbanum and botanical library has been placed in the National Museum at Budapest

WE learn from Madras that the observations made under the direction of the late Mr. Pogson are in a forward state of reduction, and that the real activity of the Observatory is not to be measured by the fact that the last published volume of Observations contains the record of those made in 1870. The funds at the disposal of the Madras Observatory have not permitted the regular and early publication of the masses of observations which the industry of Mr Pogson and his assistants has accumulated, and the scheme which the Director proposed to himself did not permit him to give, from time to time, an abstract of his work through the ordinary and recognized channels open for the dissemination of astronomical results. Mr. Michie Smith writes that the "Variable Star Atlas" alone contains the observations of about 60,000 stars, made and reduced by Mr Pogson. We may express an earnest wish that no long time may be suffered to elapse before astronomers have an opportunity of judging the value of this mass of material in an interesting branch of astronomical inquiry.

UNDER the McKinley rigame it seems to be a very generous this for an Austrian second to communicate a paper to a British society-fibe of them writes as follows to the Nation—
"A learned society of Scotland, in pursuance of its liberal policy, mailed to me fifty author's copies of a paper which had been honoured by admission to its Transactions. The bandle

came to the local post-office this week opened, and accompanied by a slip gring the package a commensial value "of waive dollars, and assessing a duty of as per cent. The local collector of customs thicks that I am resisting the just claims of a hardworking Government in delaying payment; but curiosity as to how they discover the commercial value of a paper whose real audience might, I think, be numbered on the fingers of the two hands, has teld me to appeal the case.

Science states that the executors of the estate of the late William B Ogden, the first Mayor of Chicago, have selected the University of Chicago as one of the beneficiaries, giving it a scientific school. The gift, which will amount to from three hundred thousand to half a million dollars, will endow a separate department of the University, to be called the Orden Scientific School, its purpose being to furnish graduate students with the best facilities possible for scientific investigation by courses of lectures and laboratory practice. The income of the money appropriated is to be devoted to and used for the payment of salaries and fellowships, and the maintenance of laboratories in physics, chemistry, biology, geology, and astronomy, with the subdivisions of these departments A large share of the time of the professors in the school is to be given to original investigation, and encouragement of various kinds is to be furnished them to publish the results of their investigations, a portion of the funds being set apart for the purpose of such publication.

It seems as if in time the publishers of sea-side guides may realize that some people who require a holiday are intelligent, possess eyes, and perchance even some acquaintance with natural history We have just received a copy of Johnson's illustrated 'Visitors' Companion" to Eastbourne and its vicinity, which contains, besides the matter usually supplied, an account of the flora, consisting of 291 varieties of wild flowers, 9 orchids, 18 ferns, 12 mosses and their allies, 34 varieties of sea-weeds (with directions for collecting and preserving them), particulars are also given of 56 varieties of butterflies (with time of appearance), 45 varieties of moths (with time of appearance, and how to catch them by the electric light), 29 varieties of wild bees, pebbles, fossils, land and freshwater mollusca, a brief geological survey of the district, and an extensive list of wild birds which frequent the neighbourhood, together with a guide to fresh and salt water fishing. Have we to thank Prof Huxley's local influence for this

As achistion of the successes in aclimatination achieved in Runsi will be opened at Macow, in connection with the International Congresses of Zeology and Perhatoric Archeology and Anthropology which will be held in the Russian capital in August 892. The results of the numerous experiments in accinuatization of a great variety of plants which have been made during the last twenty-five years, especially in the Ansatre domaintoin of the Empire, will be exhibited.

IN a Vice-Presidential Report to the U.S. National Geographic Society, on the "Geography of the Air," Lieut. A. W. Greely reviews the progress of meteorological science during the past year, chiefly with reference to the work of American meteorologists. Referring to the recent controversy on the causes of cyclones and anticyclones, he says :- "The status of the meteorological discussion which has been going on for some time seems to be this A number of men, applying themselves to investigation in separate branches or stages of the same science, are attempting to reconcile their views, which, based as they are upon entirely different processes of investigation, are not entirely accordant. Some at least of these writers are still apparently groping in the preliminary, the 'natural history' stage of the science of meteorology, while one alone stands as the exponent of the 'natural philosophy' of meteorology." This view ems somewhat Inappreciative, and the account given of Dr. Hann's work inadequate and not quite correct. Dr. Hann's memoir demonstrated that the temperature conditions of antievelones, and probably extra-tropical evelones are inconsistent with the convectional hypothesis as worked out by Prof. Ferrel, and he suggested as an alternative that their cause is to be sought in the general circulation of the atmosphere. But he did not originate this view, which had been put forward long before by Werner Siemens; nor did he attempt to develop it. It is incorrect, therefore, to represent this hypothesis as the main object of his memoir In connection with the work of the Weather Bureau, of which Lieut. Greely is Director, he notices the experiments of Prof. Marvin on wind pressures and velocities, which confirm the results of some previous experimenters in proving that the indications of the Robinson anemometer are too high, also that pressures computed from velocities by the usual formula are much in excess of the truth , the result being that the pressure computed from the readings of the Robinson anemometer, when the actual velocity is sixty miles per hour, is 50 per cent. too high. Other subjects briefly noticed are Finley and Hazen's work in connection with tornadoes, and Prof Russell's on cold -

In a pamphlet entitled "Physical and Geological Traces of Permanent Cyclone Belts." Mr. Marsden Manson treats of a somewhat large subject in the small space of ten pages. Starting with the assumption that the main features of the barometric zones of the earth have been the same throughout past ages as they are at the present day, and that there has always been a belt in the north temperate zone, between 50° and 60° N. lat , which is the mean track of maximum evelone frequency and low mean pressure, he infers that, owing to the diminished pressure, this has always been an axis of upheaval, and at the same time, owing to excessive precipitation, a zone of maximum denudation. His ideas are apparently suggested by the geological structure, the orographic and meteorological features of North America, and little or no attempt is made to verify his inferences by the geological and meteorological conditions of Europe and Asia, which hardly seem to bear out his hypothesis, Thus he instances the Archiean axis of Canada as the secular result of upheaval and denudation along an axis roughly coinciding with the average storm track, but he omits to show any similar relations between the Archiean rocks of Bohemia or the Alpine chain and the average course of storms in Europe. It is, however, altogether premature to criticize a theory put forward in so crude a stage of development, and it is hard to see what service can be rendered to science by such premature publica.

DR W DOBERCK has published the observations made at the Hong Kong Observatory in the year 1889 Returns were received from forty land stations, and extracts from logs of ninety three ships which visited Chinese waters were collected during the year, and will be utilized in investigations of the meteorology and typhoons of the Eastern seas. The stations in connection with maritime meteorology extend to the Island of Luzon, and a most valuable station has been established on the rsland of Formosa, by the Chinese Maritime Customs The observations of the rain-band have been regularly continued. and have been found of use both in prediction of fine weather and of heavy thunderstorms An advance Report Issued for 1890 shows that considerable improvement in the storm-warning service has been effected by the connection of the Observatory with the telegraph offices A committee of inquiry which sat in the early part of 1890, has recommended that more financial and other assistance be given to Dr Doberck in carrying out his work.

THE Central Meteorological Office of Paris has recently published its *Annales* for the year 1888, consisting of three NO. 1138, VOL. 447

large quarto volumes. Vol 1 contains -A discussion by M Fron on the character of the thunderstorms of the years 1887 and 1888, with charts for each day on which such storms occurred . a review by M. Moureaux of the magnetic observations at Park of Saint Maur, together with factimile curves of the most interesting disturbances Owing to an agreement with Greenwich Observatory, the curves published in this country and in brance will generally correspond to the same disturbances, and will therefore allow of interesting comparisons Résumés of the magnetic observations made at 53 other stations in France are also published. A discussion by M. Angot of the phenological and other periodical phenomena during the years 1886 and 1887 These observations have now been continued for eight years, M. Ancot has also studied the effect of the amount of cloud on the daily variation of temperature at Paris A paper by M. Raulin on the seasonal rainfall of various countries in Europe. in which he shows that when a number of years are taken into consideration the condensation of vapour follows a regular scasonal range, with a minimum in winter and a maximum in summer, where the range is not interfered with by secondary causes, such as proximity to the sea, &c M Teisserenc de Bort presents a paper on the mode of formation of types of sobars, and on the theory of the general circulation of the atmosphere, illustrated by diagrams Vol. ii contains the observations made at various stations and mountain observatories, including also several stations in Algeria, Egypt, Panama, &c Vol in contains values of rainfall at a large number of stations, with monthly, seasonal, and annual charts. The actual number of stations reaches nearly 1800, and daily values are published for 925 stations

A NAMARKABLE weather change is reported to have occurred at Orenburg on November 19, 1890. After a temperature of 3°C, with beavy run, there was a fail to - 30°C in 20 minutes. Some thirty Kirghines, who were returning to Orenburg, were drenched with the rain, then frozen on their horses. Ten of them had been found, and the others were being sought for. Many horses and other animals succumbed to the cold

SNOW DRIFTS are found a serious disturbance of the Russian railway system With a view to forecasting such occurrences, M Sresnewskii has lately collected information about snowdrifts on the Russian lines during 1879-89 (Rep. fur Met.) The drifts occur in the Northern and Eastern Governments, chiefly with south-west wind, but in Southern Russia with north-east, In the north, greater gradients are required than in the south. The maximum of the drifting is in mid winter, but there is more in the second half of winter than in the first, that having more snow. In course of wirter the snow grows in thickness, so that in March there is more to drift than in December. The marked diminution of drifting in February is due to the less wind in that month (a fact not yet explained, as the number of cyclones shows no decrease) Two kinds of drifting are distinguished, it may be only or chiefly snow lying on the ground that is whirled and carried along, or the wind may drive falling snow. There are most drifts in the months that have least snowfall and the smallest number of days of snow. The snow-drifts in South Russia with north-east wind are chiefly connected with anticyclones in the central region, or cyclones on the southern border, those in the east and north with cyclones in European Russia In Central Russia they occur with cyclonic winds of various direction, seldom with anticyclones.

An investigation (more comprehensive than the previous ones by Forel, Fritz, and others) of the variations of Alpine gladiers, has been recently made by Herr Richter, of the German and Austrian Alpine Clinb To six advances of glaciers, previously known, he adds three, and his account of the six differs somewhat from previous ones. The dates of commencement of the nine advances are 1592, 1630, 1675, 1712, 1735, 1767, 1814, 1835, 1875 (2). The following are some of Richter's conclusions -- Glacier advances recur in periods varying between twenty and forty five years , on the average of three centuries, thirty-five years. The advances are not all of equal intensity. nor allke in their progress. Nor is the intensity in a given advance period the same in all glaciers. In the case of some glaciers, a period is occasionally skipped, the advance or retirement being very weak, so that the thirty-five years period gives place to one of seventy years. The glacier variations corre-spond, in general, with Bruckner's climate variations. The glacier advance generally begins a few years after the moist and cool period has set in. There is no good reason to suppose that, in historic time, before the sixteenth century, the Alpine glaciers were smaller than now, or that variations occurred of different order and period from those of the last 300 years. About 1880, the earth was passing through a moist and cold period, which should have resulted in a general advance, but the advance has been but slight hitherto, and, in the Eastern Alps, mostly absent. The cause of this is not at present clear. but the mild nature of this last cold period may have something to do with it

THE bacillat of tuberculous, it is known, is often to be found in places lived in by consumptives Herr Pranaunt has lively collected the dux in various compartments of trains which often convey patients from Berin to Marra, and inoculated a number of guine-pigs with it. Two, out of five compartments we examined, were found to contain the bacillats, the dust of one rendered three out of four guine-pigs suberculous, that of the battle out of the compartments were a substantially and the substantial training the capter of mail. The fact, however, seem to point to the necessity of disinfaction of such railway cartiages, eventably the expects or mail.

To the usual well-known ways of stimulating muscles to con raction, viz electrical, thermal, mechanical, and chemical, M D'Arsonyal has recently added that by means of light. He could not, indeed, get any contraction to a fresh frog-musclewhen he suddenly threw bright light on it in a dark chamber; but having first in darkness stimulated a muscle with induction currents too weak to give a visible effect, and then suddenly illuminated the muscle with an arc light, the muscle showed slight tremulation. Not thinking this conclusive, however, M D'Arsonval attached a muscle to the middle of a piece of skin stretched on a funnel, and connected the tube of the funnel by means of a piece of india-rubber tube with the ear. The muscle being now subjected to intense intermittent light, he heard a tone corresponding to the period of illumination, and this ceased when the muscle was killed with heat. Arc light was used, which was concentrated by a lens and passed through an alum-solution to stop the heat rays

FOR nearly two years there has been at work in Denver, Colo, an automatic refigerator system, which seems to be thoroughly successful. Ammoniscal lugor in the proportion of 29 parts present in Stored through a nann to the policy of the proportion of 29 parts and the proportion of 29 parts and the proportion of 29 parts affected there for quick supermixtun, and after absorption by afforded there for quick supermixtun, and after absorption by water, the luquid returns by section to the central station. There are not mits of mains having connection with tenstyrance boxes, each containing a grill near the top to which the luquir is thouch the proportion of the proportion of the state of th

clean, the moisture collects on the grill as frost. In one experiment a piece of meat was kept six mopths and then cooked and eaten, and it seemed no way different from fresh meat

THE French Sociéte de l'Encouragement lately offered a prize of 1000 france for conservation of potatoes and other vegetables. Four of the five applicants used some isolating substance (woodash, sawdust, rve-straw with sand). M. Schribaux, who calned the prize, puts potatoes for ten hours in a 11 per cent solution of commercial sniphuric acid to kill the buds (a 2 per cent. solution for thick skins). The potatoes are taken out and thoroughly dried, and they will keep without alteration more than a year. The same solution serves for repeated immersions, the concentration remaining constant. The process is not applicable to Another prize by the same Society (3000 francs) is awarded to M Candlot for a memoir treating of the action of sea-water on cements. He shows that the sulphate of lime resulting from decomposition of sulphate of magnesia by limesalts of the cement combines with aluminate of lime to give a double crystalline salt containing half its weight of water. The crystallization of a salt so greatly hydrated involves considerable swelling, and this accounts for the disaggregation of cements in marine work M Candlot has observed the curious fact that over baked lime, which takes several days to extinguish in water, is extinguished in a few minutes in a 3 per cent solution of chloride of calcium. This is thought to have important practical bearings.

M RASPAII has lately called attention, in the Zoological Society of France, to the serious diminution of birds in that country through destruction of their nests. Some insectivorous species are becoming very rare, while the rayages of parasites on useful plants are extending Boys, of course, do a great deal of the mischief, and of the various animals which attack nests (the squirrel, the hedgehog, the dormouse, the magnie, &c) M Raspail regards the cat as the worst offender On a recentlywooded property of about 7 acres he observed last year as follows -Out of 37 nests, carefully watched, only 8 succeeded : 29 were destroyed, 14 of these by the cat, though effort had been made to ward off this insatiable marguder. On a large property in the centre of a village the owner had about 80 cats annually caught in traps. The place having lately changed hands, the gardeners estimate that more than 100 Bests were destroyed last year, three fourths of these by cats M. Raspall advocates a rigorous application of the law for protection of insectivorous species, the disqualification of the cat as a domestic animal, and the giving of prizes to foresters and others for destruction of all animals which prev on eggs and young in the

TOBACCO fermentation, a very essential process, is brought about by firmly packing ripe tobacco in large quantities. It had been generally supposed that the fermentation is of purely chemical nature, but Herr Suchsland, of the German Botanical Society, finds that a fungus is concerned in it. In all the tobaccos he examined, he found large quantities of fungi, though of only two or three species Bacteriacese were predominant, but Coccacese also occurred. When they were taken and increased by pure cultivation, and added to other kinds of tobacco, they produced changes of taste and smell which recalled those of their original nutritive base. In cultivation of tobacco in Germany it has been sought to get a good quality, chiefly by ground cultivation, and introduction of the best kinds of tobacco. But it is pointed out that failure of the best success may be due to the fact that the more active fermenting fungi of the original country are not brought with the seeds, and the ferments here cannot give such good results. Experiments made with a view to improvement on the lines suggested have

A PROPERABLE INSIGHT, build, beard of, is carried on among the fill for Connectivat (Ser. Am.). It as the manufacture or butch oil, which is used largely for confectionery, and gives a refect wintegreen flavoir. There are eight noils in the State—the first built only ten years ago. Burch brush, without longage, and notiver 24 inches in diameter, from the black, mountain or reager burch (not the yellow or white), is chopped up and holled with water to inside. The team, passing through an iron pipe near the top, is condensed in a coil immersed in rounning water, and drops into a glass jur. The oil is much heavier than water, and in the crude state is of copper has the mills work only from October to Apul A good deal of adulterated birch oil is used in tanning leather to imitate Kusua leather.

WE have just received the Report for 1890 of the Botanical Exchange Club of the British Isles There are about fifty members, and a list of the plants that are wanted is sent out every spring. The Secretary is Mr Charles Bailey, Ashfield College Road, Whalley Range, Manchester The distributor for last year was the Rev. E T Linton, one of our most pains taking British botanists, and the Report is edited by him number of specimens received was 4100, from twenty six con tributors. The most interesting novelty of the year is an Arenaria found at the head of Ribblesdale, in Yorkshire, which is nearly allied to, but not quite identical with, 4 nor vegica, known only within the British area in the Shetland Islands and Orkney, and I ciliata, known only in County Sligo Mr. Linton treats it as I rothica. Fries , but that plant is an annual, whilst the Ribblesdale plant is a perennial It is, in fact, a form about half way between normerua and cothica Out of thirty eight pages of the Report, eleven are occupied by Rubi. A new general working up of the British Rubi is much wanted, and it is evident the different referees to whom the specimens have been sent do not use some of the names with the same application or range of significance. What beginners want are good typical specimens of the most distinct forms To give their the intermediate connecting links before they know thoroughly the typical sub species only bewilders them roses the difficulty is that it is often impossible to determine a given plant positively without seeing it in three singes-flower, young fruit, and mature fruit-and nearly all the specimens sent to the Club arrive in a single stage. The above remark applies to R mollis and tomentosa, concerning which there are eleven paragraphs in the Report, none of which tend to any real en lightenment. To Hieracia the same remark applies as to Rubi , but Mr. F A. Hanbury's elaborate monograph, now fairly started off, will put this right. Three other sets of plants are at present receiving much attention from the members, se, hybrid willows, hybrid Epilobis, and Potamogetons At the end of the Report there is a long list of new county records

THE additions to the Zoological Society's Gardens during the past week include a Brown Capuchin (Cebus fatuellus 9) from Guiana, presented by Miss Phyllis Duncan, a Red-bellied Squirrel (Scene us variegatus) from Trinidad, a Golden Agouti (Dasymocia aguis) from Guiana, a West Indian Agouti (Dasy procta cristata) from the West Indies, two Violet Tanagers (Euphonia violacca) from Brazil, presented by Mr. R J. L. Guppy, C.M.Z S ; a Common Otter (Lutra vulgaris), British, presented by Mr D E. Cardinall , a Marbled Polecat (Putorins sar maticus) from Quettah, presented by Colonel C Shepherd . a Vuloine Soulrrel (Sciurus vulpinus) from North America. presented by Miss Pickford , seven Lemmings (Myodes lemmus) from Norway, presented by Mr. T. T. Somerville, two Sparrow-Hawks (Accepter misus), British, presented by Mr. Digby F. W. Nicholl, F.Z S.; a Grey Parrot (Psittacus erithacus) from West Africa, presented by Mrs. Hale; a Golden Eagle (Aquila

chymacsis), European, presented by Capisan Tsylor; a Common Chameleon (Chameleon vilcas) (from North Africa, a. Dwaf Chameleon (Chameleon Vilcas) (from North Africa, presented by Capisan Wood, is to Common Chameleons (Chameleon vilcas) (from North Africa, presented by Mr. E. Palmer; as Egyptian Ichneumon (Infrastes twin winse) from Span, a Blackheaded Calque (Casto melanocybula) from Denesara, deposited; a Vak (Irohafong virmunus), hom un the Gardens

OUR ASTRONOMICAL COLUMN

PERIODIC VARATIONS IN THE LATTIUDE OF SOLAR PROMINENCE—From a paper by 176 Rice), in Comptate conduct for August 3, it appears that the meen lantitude of solar results for August 3, it appears that the meen lantitude of solar prominences varies periodically in the same way as that of sports, and the same of the solar prominences and the same way as that of sports, and dimension of solar prominences have been made at Palermo an 2207 slays, with the same refractor and spectroscope. In this period food prominences have been observed, having a height period to or greater than 30° Neglecting a few irregularities, excitivity prominences occur neasest the sam's equator, the mean intuited for both hemispheres in the second vera refer the last maximum being 37° 5. There is then a rapid general increase in the latitude of most frequent occurract, upon other frequent courtered, upon the same size of the s



of spins according to Prof. Sporer's observations, and three found from the profit of the Currefound from the profit of the Currefound from the parallel to each other, and are separated by an
approximately equal number of degrees at all points: It is
worthy of remark that the photographs of the solar corona
recently investigated by Prof. Biggiove exhibit a movement in
littude which is most probably connected with the latitude,
variations of sina-posts and prominences:

PHOTOSCHAPHY OF SOLAR PROMINENES AND THEE SECTEMA — In the American Journal of Sizence for August, and Attenuan has Medicated as Son 505, Prof. C. If East piece of Sizence is the Sizence of Sizence in the S

liarly useful as backgrounds for the bright prominence lines, and

liarly useful as backgrounds for the bright promuences lines, and allows the use of a wide allo. Working with a tangential alli, Frof Hale has obtained excellent photographs of revertals of Hand K. The former line is found to be double, the compation being about 1 y sent-metres less refrangible, and position of the properties of the be made while the exposure to the H and K region is going on.

Certainly, if Prof. Hale should be able to do for invisible proobservable, our knowledge of the relation between the two classes of phenomena and their connection with sun spots would be considerably extended

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

THE following is the list of candidates successful in the competition for the Whitworth Scholarships and Exhibitions, 1801 —

The total county of the county

SOCIETIES AND ACADEMIES PARIS.

Academy of Sciences, August 10.—M Duchartre in the chair —Artificial production of a micaceous trachyte, by MM. Societies and Academies NO. 1138, VOL. 44]

F. Fouqué and Michel Lévy. This trachyte was obtained by the action of water under pressure on a glass resulting from the fusion of Vire grante, and at a bright red heat. The rock was homogeneous, and its sections exhibited beautiful octahedral crystals of a warety of spinel in connection with orthodrae and black muce. Note on an experiment on ostrocilotrac that has been Synking and the service of the property of the service with orthogeneous curred out in the full-point of the Rossoff Laboratory by M. H. de Lacaze-Duthers—Flyasological research on carbon most die in a medium containing it in the proportion of one tenthousandth, by M. N. Grebant. After passing a muture containing at tenthousandth part of exchan mosting through of the blood was diminished from 23 7 to 23 o per cent. The difference (2) Propresents the amount of oxygen replaced by earbon monoxide. When the gas was passed through under a pressure of five atmospheres, it was found that the respiratory capacity had diminished from 23 7 to 172. This result may be in confined are, and it also indicates that it is not only the perin confined air, and it also indicates that it is not only the per-centage proportion of the gas which must be considered in questions relating to the absorption of it by hiemoglobin, for this questions refating to the absorption of it by hemoglobus, for this remained the asseme hosh experiments, vir., rying-lib.—On the refating and dispersion of crystallized chlorate of soid, by Mr. of the refating and dispersion of crystallized chlorate of soid, by Mr. of the continuants the refrestive index of chlorate of soid, at temperatures between 0° and 30°, and for twelve lines in the spectrum. For the sodium line (D) and a temperature of 20° the value of the continuants of the co action, by M. Maurice Mendelisohn—On the preventive in coulations of yellow fever, by M. Domingos Freire. The author has inoculated 10,881 persons with cultures of Microseccus amari. The mortality of those so vaccinated wass of per cent, although the patients lived in districts infected with yellow fever, which the death-rate of the uninoculated during the same period was from 30 to 40 per cent. These results have led the Govern-ment of the Brazilian States to found an institute for the culture of the virus of yellow fever and other infectious diseases, and to appoint M. Freire the director.—On a new incandescent light, by M Bay.

Letters to the Editor :-	
Aerial Roots of the Mangrove Alfred W.	
Bennett	370
The Tasman Sea -Prof. A. Liversidge, F R.S	371
Reduplication of Seasonal Growth -Dr. A. Irving .	371
Rain gauges -Thos, Fletcher	371
The British Association	
Inaugural Address by William Huggins, Esq.,	
D C.L (Oxon), LL D. (Cantab., Edin , et	
Dubl.), Ph D (Lugd. Bat.), F.R.S , F.R.A S.,	
Hon F R.S.E., &c , Correspondant de l'Institut	
de France, President	374
Section A (Mathematics and Physics)Opening	
Address by Prof. Oliver J. Lodge, D.Sc.,	
LL.D., F R.S., President of the Section	382
The Late Prof. Martin Duncan, F R.S	387
Notes	388
Our Astronomical Column:-	
Periodic Variations in the Latitude of Solar Promin-	
ences. (With Diagram.)	391
Photography of Solar Prominences and their Spectra	391
University and Educational Intelligence	392

CONTENTS.

The Congress of Hygiene . . .

PAGE

393

THURSDAY, AUGUST 27, 1891.

THE CONGRESS OF HYGIENE.

TE continue this week our account of the work done at this Congress. It will be clear that with the space at our disposal it is only possible to refer to few among the many subjects discussed Among these we have selected those which have the closest connection with those researches now attracting special attention.

In regard to the subject of tuberculosis it was certainly a happy inspiration of the officials of the Bacteriological (II.) and Comparative Pathological (III) Sections of the International Congress of Hygiene and Demography, to call a joint meeting in order that a full discussion of the scientific and practical bearings of the questions relating to "the transmission of tuberculosis from animals to man by means of flesh and milk derived from tuberculous animals" might be possible, and it was also fortunate, as far as its success was concerned, that the discussion was opened by Profs Burdon Sanderson and Bang, each of whom in his own sphere is singularly well fitted to lay before the members of the Sections what is at present known in the medical and veterinary scientific worlds concerning this important subject. Prof Sanderson's early researches on tuberculosis have opened up the way for much of our present knowledge on the subsect, in addition to which he has watched the question most carefully through its various stages of evolution, whilst Prof. Bang, by his numerous practical observations and scientific experiments, has given a completeness to our knowledge which has not been attained as the outcome of | teids, that it is rendered very much less digestible; and the work of any other observer

The discussion on this question afforded another instance of the intimate connection between the purest research and the most practical affairs of every-day life.

Thus from the tenor of the discussion it may be gathered that the danger arising from the ingestion of tuberculous milk and meat has probably been exaggerated.

Some of those who took part in the discussion, for example, seemed to doubt whether primary tuberculosis of the alimentary canal-re. tuberculosis confined to this region and evidently the result of infection through the mucous membrane -was ever met with in adults, and even whether it was of very frequent occurrence in the child . whilst other speakers were able to instance out of their own experience certain cases of the former and many of the latter, strongly accentuating the fact that such primary disease of the intestinal canal does exist. Then, again, one speaker was convinced that Koch's bacillus had little or nothing to do with the production of tubercular disease . but the contention had been met by so many accurate observations and experiments that he may be said to have been ruled out of court, though it was on all hands agreed that the bacillus might be helped in its work by various predisposing causes, many of which were brought into full prominence during the discussion. It was also accepted that the tuberculosis of cattle is similar, as re-

gards its causal agent, to the tuberculous of the human subject, and that the disease is merely apparently modified owing to the different conditions, and perhaps delicate tissue modifications, offered by the different hosts of the parasitic bacillus; and from the most careful and detailed experiments, of which a large number were described. there seems to be no question that tuberculosis is communicable from animals to man, and certainly there appears to be none that it is communicable in the opposite direction.

There was a general expression of opinion as the outcome of the discussion that legislation of some kind or other is necessary, but, as pointed out by Burdon Sanderson, if laws were made to morrow there is absolutely no staff of inpectors capable of giving effect to any that might be drafted It is probable that this will draw attention, first, to the necessity for conferring powers of inspection of dairy and store cattle on some central authority; and second, to the necessity there is that our veterinary surgeons should undergo a thorough scientific and practical training, such as would fit them to fill the posts from which unfortunately they are necessarily now in many instances excluded

When all is said and done, it appears that the danger arising from the consumption of tuberculous meat is far less serious than that involved in the consumption of milk from tuberculous animals, as meat, if thoroughly cooked, appears to be perfectly innocuous, the tubercle bacilli being readily destroyed by heat, whilst the nutrient properties of the meat itself are little, if at all, interfered with by judicious cooking. In the case of milk, however, in which the presence of tubercle bacilli has been so often demonstrated, it has to be borne in mind that boiling so alters the constituents of the milk, especially the proits nutritive value is greatly interfered with

We now pass to the discussion

TUBERCULOSIS IN ALL ITS RELATIONS.

Prof Burdon Sanderson said the subject which he had under-taken to bring before the notice of the conjoint Sections for discussion was one of the gravest importance, for there was no disease, acute or chronic, which was so productive of human suffering or so destructive of human life. In a Concress of Hygiene the subject of tube culous could only be considered in relation to its causes, the aim of hygiene being to prevent disthose questions which relate to the dangers which are alleged to arise from the use of tuberculous food (1) Does general luberculosis in man originate from intestinal infection? (2) If it does, is it possible to guard against so fearful a danger? the purpose of avoiding useless discussion on subjects on which there each to be perfect agreement of opinion, he asked that certain fundamental propositions should be accepted as settled, such as, for example, the existence of a materies more in the form of the tubercle bacillas, its constant association with the tuberculous process, and the identity of human with bovine tubercle; and also that it be assumed that any part of the body of a tuberculous animal or any secretion of such an animal would, if it contained tubercle bacilli, be a source of danger, and would, I'll contained tuberrie uscill, no a source or stanger, and that they use of such inquid or part ought to be prohibited or on the quantum and the properties of the properties of the logical or stilogical, the others practical or admunitrative. The collogical questions might be said to relate to the three possible ways in which a human being may be infected by tubercle— namely, inheritance, pulmonary inhikation (temospheric infe-tion), and food (enteric meterion). The practical issues were—

(1) Is the risk to the individual consumer of such a nature that it can be detected and estimated?
(2) Is it of such a nature that it can be counteracted?

(3) Is the collective risk to which the community is exposed sufficient to demand the interference of the State? and

sufficient to demand the interference of the State? and (a) If it is, I how can the State Interfere with effect? (d) If it is, I how can the State Interfere with effect? (d) If it is, I how can the State Interference Interfere

chedly from the point of view of the vetermarian In 1888, M. Adiong, following out the principles enunciated by another gifted pathologist, the late M. Toussaint, that tubercle is a diverse total uniform to engineer annatumed that the time had come to act "conformant à la logique." One out of every six carcasse had been shown, he said, to be infective, when tested by administering it to test animals as food. If calculated that over one thousand persons joined in the conformation of sumption of every such carcass, and consequently that one-sixth of this number—that is, about 170 persons—must be subjected to the risk of infection for every animal sent to the shambles If this reasoning were true, if we could measure the danger to to this reasoning were true, it we could measure the danger to the human consumer by the presence of tuberculous among animals used for food irrespectively of other considerations, then M Arloing was right in his practical deduction from it that whatever interests conflict with public health they must give way It was our duty to insist on the right of science to dictate : but in doing so it was necessary to be careful not to do so until the question had been looked at from all sides and the whole evidence

had been heard. In some of these discussions it had not been sufficiently considered that the question was not whether the consumption of tuberculous meat was in itself attended with risk, but whether the presence of tuberculous diseases among ourselve, was in any the presence of tunerculous diseases among ourselves was in any way due to the fact that we occasionally eat meat which contained bacill. It was not sufficient to show that on the one hand there was a fearful mortality from tunerculous diseases, and that on the other there existed a cause to which this calamity might be attributed. It must also be shown that the effect was actually produced by the cause, in such sense that if the cause were removed we might hope that the effect would disappear

Twenty-three years ago Chauveast fed three heifers with tuberculous material from the body of a cow and obtained positive results. At that time the idea that tuberculous was a virulent disease was new M Villemin had made his great discovery, but it had not yet been accepted, and consequently Chauveau's results were severely criticized, and were the subject of much discussion, which extended over several years (1868-74), during which he repeated his abservations, effectually silenced his opponents, and determined with the greatest exactitude all the conditions which are required to insure success in the experimental pro-duction of tuberculosis by feeding. Gerlach about the same time made similar experiments in Germany which led him to advocate in the most energetic manner the restriction of the sale of tuberculous meat.

These two mittal investigations were followed by many others. In 1884, Baumgarten showed that a couple of ounces of milk to which a pure culture of tubercle bacillus had been added were sufficient to produce characteristic tuberculosis in the in-testines of a rabbit; and that the effect of such feeding was so constant that by examining the animals so fed at successive constant that by examining the animals to led at successive periods all the larges of the process could be thoroughly investi-period and the larges of the process could be thoroughly investi-lation; of a fortnight, during which no traces of infection were viable, the lymphatic follicles of the mucous membrane and the mesentence glands began to enlarge simultaneously without any change whatever in the intestinal epithelium.

It was thus shown with a precision which was not before ob-tainable that the initial phenomenon of tuberculosis was primarily a proliferation of the adenoid issue of the lymphatic system, and that the bacillus was capable of finding its way into the lym phatic system without leaving behind it any appreciable traces of its presence at the portals by which it had gained admission Since 1884 our knowledge of the subject had been still further advanced by Cornil, under whose direction two very important researches, confirming and extending Baumgarten's results, have been recently published, from which it was evident that when

the tubercle bacillus is absorbed from the intestine it follows the course of the lacteals, and that the lesions which it produces correspond closely with those which present themselves in those rare instances in which it is possible to observe the first begin-

nings of enteric tubercle in the hunan subject

Much, however, has still to be learned by the experimental muen, however, has still to be learned by the experimental method—information which could only be guized by observation on animals. According to those who regard tuberculesis as ancessarily a disease, believe institution to organize the body is contaminated, all meat derived from the body of a tuberculova named another to be contaminated. part of the body is contaminated, all mext derived from the body of a tuberculous animal ought to be condemned, whether it appears healthy or not, for they argue that in every such animal, however localized the disease may be, bacilli circulate in the blood, and are so universally distributed

Prof Sanderson believed that this was not true, and that we are not entitled to assume that the flesh of every tuberculous animal is infectious unless it be proved to be so. As against the animal is infectious unless it be proved to be so. probability of its being so, it must be noted that the tubercu-losis of cattle, although the product of the same bacillus as the tuberculosis of man, is a disease of comparatively slow progress It localizes itself in structures which are not essential to life, and It localizes item in structures which are not essential to the, and nutrition might be so little interfored with that the animal could be readily fattened for the market. There was no doubt that the fish of such animals might be to all appearances in good condition, and might be offered for sale as meat of prime quality, and as yet we have no evidence that it is infective.

Turning from the source of infection to its effects, from the bacillus to its field of disease and death-producing action, I'rof Sanderson said that tuberculous diseases contribute something like 14 per cent to the total of deaths from all causes, and that during childhood, as distinguished from adult life on the one hand and from infancy on the other, tuberculous mortality/scarcely amounts to a quarter of this percentage, whereas in infancy it only falls a little short of it, and in early adult life. it very far exceeds it

There was evidence that under certain conditions the virus of tubercle was absorbed by the lymphatic system from the small intestine in man, and that when this happens it may give rise to lesions of the same nature as those produced in animals by the injection of liquids in which bacilli are suspended—that is, to disease of the intestinal mucous membrane, although very cou-mon, never occurred in the adult and very rarely in infancy as a primary disease. In the adult it might occur as an ulterior consequence of pulmonary consumption, the way in which it occurred being very evident. In the advanced stages of that disease muco-pursient inpul was discharged in quantity from might infect the mucous membrane along which it passed so that it is easy to distinguish bronch which lead from vomme by the tuberculous nodules with which they are more or less best. In advanced philine the putture is to shundant that a certain proportion of its from time by time study. For closely offer the proportion of the free constitution of the constitution o primary disease In the adult it might occur as an ulterior conpasses too rapidly, while in the latter the mucous membrane is effectually protected by the gastro junce, which, although mea-able of devitaling the bacilits of tubercle, areast its develo-ment. In the alkaline contents of the small intestine a condition more favourable to its development was found, and from there it was absorbed, just as any other particle of similar size might be, by the lymphatic follicles. Tuberculous disease of the small intestine in the adult thus occurred. It was always a

secondary result of pulmonary phthsis.

In childhood the case is different. Tuberculosis does not begin to assert itself as a cause of death until the third month of extra uterine life, but after this there was good reason for sup posing that the bacillus plays an important part as a cause of mortality.

mortality.

mortality of the plant is question of how latent tuberculous of the papather system or of bose oreginates, as how the hacillity which produce them are introduced into the blood aream was one of great interest. Prof. Sanderon confessed it to the his belief that m a certain proportion of cases the cryptogenetic proportion of the proposition of and that the mucous membrane of the intestine is tuberculous in a still smaller proportion—less than a quarter. In many of these cases the mucous membrane was no doubt affected subsequently on tuberculous disease of the lungs, but in the remainder the disease seemed to be primary — If it could be proved that such cases were primary, the fact would afford clearer evidence than any we now possess of the enteric origin of tuberculosis.

than any we now possess of the esteric origin of tuberculous.

In the absence of such proof, human pathology had very little
indeed to say in favour of the bellef that human tuberculous
could owe its origin to the convumption of tuherculous food, and
even if it were proved that the absorbeats afforded a channel of
entry for the tuberculous versu in children it would have little

significance as regards the consumption of mest.
The author beld, therefore, that we are not as yet in a position to demand the interference of the State on the ground that the community actually suffers from the consumption of ubbrealous meat, the evidence that it is so being too weak to be insisted on, but he manitumed that the consumption of subervicelous meat was attended with some danger, and that on that ground its was attended with to be prevented by the State and avoided by the Individual.

and regards the administrative question, he held that if we held, to-morrow, a law forbidding the sale of any mest containing the bacillas of tubercle, it could not be carried out unless those charged with its administration were able to distinguish such charged with its administration were able to distinguish such the law would depend on the question whether the art of discriminating between infecting and non-infecting mest had attained to such perfection as to enable an adequately transcell discriminating between infecting and non-infecting mest had attained to such perfection as to enable an adequately transcell interested for contamption should be withpeted to inspection, interested for contamption should be withpeted to inspection, interested for contamption should be withpeted to inspection, adequate compensation, but all this would be of no use unless the principles on which the discrimination of infecting from non-infecting mean in to be founded could be laid down, and the the principle of the principle of the discrimination of the contamp of the discrimination of the contamp of the discrimination of the discrimination of the contamp of the discrimination of the discrimination of the contamp of the discrimination of the discri

but by practical skill.

Dr Sanderson then submitted the following propositions to the meeting of the combined Sections —

(1) That tuberculous must be added to the list of disease regarded by the law at contigons. There is no sufficient reason for supposing that in the human adult the introduction of the bacilli of tuberclib by enteric absorption is the efficient cause of the particle of the control interpolar tuberculous diseases of the lymphatic system are probably due to the penetration of bacilli into the organism from the missine; but the evidence which we at present possess on his subject is not sufficiently precise or extended to server as tuberculous in a lifancy is a subject which trigently requires investigation.

investigation.

(a) It has been proved that the ingestion of any material which contains the bacilli of tubercle is a source of risk to the consumer, but the conditions which limit this risk are insuffi-

ciently known. It would, therefore, be unjust to enforce the destruction of any specimen of meat apparently healthy, even though it were known to be derived from a tuberculous animal, excepting on evidence given as regards the particular case that it would be infecting if administered to test animals.

trough it were known to no enrived from a tunerculous animas, accepting on evidence given as regards the particular case that excepting on evidence given as regards the particular case that (3) As regards the duty of the State in relation to the prevention of tunberculous, what is immediately required in that an efficient system of skilled inspection should be created. Thus it desirable, not merely as a first step toward, a prevention of the sale and consumption of tunberculous meat, but as an indispersable means of acquiring better information than now exist. To be of use it must be confused by men of technical skill wit forth. It must be confused by men of technical skill wat forth.

sating under scientisic guidance
"In conclusion," said Dr Sanderson, "I would beg you
to notice that I have limited myself to the question of the
consumption of sense. Although I have purposely left the
source of the sense of the sense of the sense of the
minds bear upon it. We have seen it to be exceedingly
probable that about 40 per cert of the children that die
in hospital, die tuberculous I have alrealy expressed my
stylependent on causes which have operated before hirth.
Some are probably infected by inhalation of the tubercle bacilise
from the aimosphere, notwithstanding that pathology affords so
satisfactory evidence, I cannot result the conviction that the consamption of unboided mild during the years which follow weaning
must have its share in bringing about the fatal previdence of
sell that, whatever course may be taken as regard in users, I can
jonn hearnily with those who tlank that the sale of contaminated
fills of the sell o

Dr Bang, Lecturer in the Royal Veternary College, Copenbagen, in a paper on "The Alleged Danger of consuming the apparently Healthy Meat and Milk of Tuberculous Animals," stated that the great majority of investigators are agreed that the essential source of tuberculous is man is found in man himself, but almost all admit that he may contract the disease through the ingestion of milk derived from animals affected with tuberculous.

It is always agreed that such a danger exists, but as to the extent of the danger there is little unanimity.

Of course, it might be said that there would be no danger if

Of course, it might be said that there would be no danger if the use of meat and milk from the tuberculous animals were entirely interdicted, but it must not be quoted that the application of such a stringent measure would, existed enforcing loss where the fivessee has a very wide distribution amongst bowne namials. He looked upon the general application of the French regulations as out of the question, at least for the present, which such a course appeared on the whole to be unnecessary. As regards milk, the question of prophylaxs was comparatively enabled that the such as the contraction of the property of the contraction of the property of the contraction of the property of the present such that a should never be employed. How can we protect ourselves against the products of milk?

The experiments made by Galter, the saturb, Hum, and other.

The experiments made by Galifer, the author, Hum, and otherhave proved that the various products derived from milk, batter, cream cheese, cheese, and batter milk may all contain tubered period of from Goutteen to thirty days. It was true the majority of these bacills may be separated from milk if the cream berevoed by means of a centringful enabline, as a generally done money of the control of the cream between the control of the control of the wind that the control of the cream between the control of the control money of the control of the conbefore charming to a temperature high enough to kill the tuberels of the control of the control of the control of from 60° varue, so far as to render t incapable of setting up infection of the alumentary canal. This method is coming more and more into use in Demanri, as by it several other vources of infection in the butter are also neutralized. As however, many popular to the control of th

that when the udder is affected with tuberculosis there are usually numerous bacilli in the milk, which is consequently exusually numerous Bacilli in the mile, which is consequently ex-remely dangerous. But he also finds that manmary toberous abundance of Copenhagen, for example, it has been found that only in 1 per cent. of tuberculous cattle was there disease of the udder. From twenty-eight tuberculous cows, in which, how-ever, there was no disease of the udder, the milk was supected into forty sight rabbits, and in only two was there any positive result. He then inoculated forty guinea pigs with milk from twenty-one tuberculous cows, in this case with four positive results. Recently he had carried on a new series of experiments with the milk from fourteen extremely philipsical cows In this series the milk was virulent in three cases, so that from saxiy three tuberculous cows the milk contained virulent tubercle bacilli in nine cases only. All these cows were affected in a very high degree, and it is probable that in some at any rate the uider was affected, though this could not be demonstrated in the living animal, as it was in three out of the four cases of the second series. Others were affected with miliary tuberculosis in second series. Others were affected with military tuberculosis in the different organ, a condition which one rarely finds in an animal that is still giving milk, and in one case the sapramammary lymphatic glands were affected with tuberculosis, although no lesions in the udder itself could be demonstrated. In several of the positive cases the number of bacilli in the milk must have been very small, as one only of the two guinea-pigs experimented upon succumbed to the disease, this happen-ing in three instances.

It should be added that the quantity of milk injected in the later series was larger than in the earlier series. In the two later screek was larger than in the earlier series. In the two first series 1 of 3 c.c. was injected, in the third 5 to 10 c.c. He maintained that, although in many cases the milk from phthiascal cows is not virulent when the mammary gland is unaffected, it is in a certain proportion of cases, and should always be looked upon with susplicion, and that it is abolutely necessary to take prophylactic measures against the use of such milk, although the danger should no doubt not be exaggerated.

the danger should no doubt not be exaggerated.

Mat.—The his tied very seldom contains any ubserile. NeverMat.—The his tied very seldom contains any ubserile. Nevermancle jusce may contain tubercie bacille, but such cases, according to the observations of Charaves, of Ariolog, Feoth, Galtier,
Nocard, Kastner, and others, are absolutely in a minority
Nocard, Kastner, and others, are absolutely in a minority
found only ten in which the immedie junes gave endence of vivaince on injection into rabbits or guinet-pigs, and sometimes
the julica inocalized only produced the disease in one of several

anunals moculated.

animals inconnated.

M. Nocard's experiments in this connection are very interesting. He found that when a culture very rich in bacilli was injected into the veni of the ear of a rabbit, the muscle juice of the animal was virulent only when it was killed within five days after the incoulation, from which he argued that the bacilli carried by the vessels to the muscles only preserve their vitality for five days. If to this experimental result be added the ob for nive days. It to this experimental result be added the ob-servation that tubercle is very seldom developed in the mucles, servation that tubercle is very seldom developed in the mucles, loss, it must be concluded that muscular tissue is a soil so in-favourable for the growth of tubercle bacilli, then, that can be found in the field of tuberclous saminals as layers extremely found in the field of tuberclous saminals as layers extremely limited. It is of course true, as M. Arloing has objected to M Nocard's conclusions, that the circulatory system of a tuber-culous animal can continually receive into it fresh bacilli, and therefore until within only a few minutes before the animal is slaughtered. But, on the other hand, it must not be forgotten that it is only in the case of the development of an acute miliary that it is only in the case of the development of an acute minary unbercalous that one can suppose that the number of bacilit inunbercalous that one can suppose that the number of bacilit inunbercalous the case of the

unimportant part in the result obtained.

Prof. Bang stated that he had recently completed a series of experiments on the virulence of the blood of cows in an advanced stage of tuberculosis. From twenty tuberculous cows he moralated thirty-eight rabbits and two guinea pigs with defibrinated blood, injecting from 10 to 18 c.c. (in four cases only 5 to 9 c c.). mjecting from 10 to 18 c.c. (in foor cases only 5 to 9 c.c.). In eighteen cases the results were negative, in two positive, and one of these in which the lesson was small was one of two rabbits in-jected with blood from the same cow. The cow that supplied the blood with which the other positive result was obtained had developed acute miliary tuberculosas after an injection of tuberculon. Three weeks previously blood from the same cow had given negative results. Even amongst those cases in which the results were negative there were several cases of acute miliary

He concluded from the foregoing that the seizure of all inberrre concused from the foregoing that the setzure of all ther-citious animals is too stringeria measure. So long as the tuberculous is strictly localized, the meat is not a source of danger, where the malady is generalized, the consumption of the meat may be dangerous, allhough it is not always so. The eating of uncoded meat should be discouraged, but the best means of avoiding danger to the health of man is to take all possible measures for preventing the propagation of tuberculosis amongst our domestic animals.

Prof Ariong, of Lyons, contended that the question of transmissibility of tubercelosis from animals to man was one of vigerest importance, but he adminted that the daggards private was represent programs, but he demonstrated that the daggards private was great, and he thought could scarcely be esaggerated. Moreover, he held dvery strongly that, except under certain special circumstances, the total condemnation of between the was necessary, and on grounds of public health he dissented entirely from Dr. Bang's position. The fest of all tubercelous sundamins should be suspected as

dangerous to health, the more so as mest was very often indangerous to heatin, the more so as mest was very outen in-sufficiently cooked, the haddlip resent under these conditions remaining pathogenic. From satistics he had gathered, he felt no doubt on this subject, and although it might be possible, by first carefully cooking under public supervision, to allow to fish from animals in which the tuberculous was localized to be sold, he still maintained his position that total confiscation of the sour, he still maintained his position that total connection of tuberculous meat was the safest method to be adopted. It was necessary, however, that in the first in-tance we should have a system of strict inspection, not only in our large towns, but also in all the smaller centres of population.

A paper was then given by Prof. M'Fadyean (Edinburgh) and Dr. Woodhead (London), on the transmission of tuberculosis from animals to man, by means of flesh and milk derived from tuberculous animals They maintained that the evidence as to the transmission through the flesh or milk of tuberculous animals was transmission tarongo the near or mile of tuberculous animals was very conflicting, apparently in great part because the methods used were different, and the conditions were not uniform. They had attempted to follow the line of infection of tuberculous in a number of children, and had found that in 127 cases analyzed number of children, ann nat sound inax in 127 users manayers unberted of the intestine was present in 43, 124 of these cases occurring between one and five and a half years; tuberted of the meenteric gland was found in 100 cases, or in nearly 79 per cent of the whole, here, again, 62 of these occurring between one and five and a half years, and of it cases in which the one and a read a native years, and of 14 cases in which the mesentence glands were primarily affected—i.e. no trace of tubercle could be found in any other part of the body—were referred to the same period. It was noticeable that of these foo cases only 20 were diagnosed during life as suffering from about must lubercle. From all that could be learned from these cases (and reference could be made to a large number of other sets of statistics practically proving the same point), it was evident that intestinal and mesenteric tubercle are inost frequently met with in children during the period after they are weaned, at which time cow's milk has been substituted for mother's milk. pant of entrance appeared in these cases to be by the intestine. They had come to the conclusion that in some cases at least the tubercle bacilli had passed from the intestine into the mesenteric glands without leaving any trace of lesion to indicate their point of entrance. There could now be no doubt that tubercle health of enrance. There could now be no doubt that tubercle baselin were sometimes present at the male from tuberculous catie, on the could be a supported to the male from tuberculous catie, or bins from the could be considered to colonia such bandle embedded in the epitheliam of the milk duct, or lying free in the ducts after the death of the animal They concluded that wherever the presence of a tuberculous the colonial could be considered that wherever the presence of a tuberculous behinder that the considered that wherever the presence of a tuberculous behinder to the considered that where the considered that where the considered that the co

poor classes, where the standard of health is exceedingly low and the hability to catarrhal conditions very great. From a series of incottalions with tuberculous udder, and with milk from tuberculous udders, it out of 10, or over 70 per cent, had given possitive results; with non tubercular udders, and with nulk from otherwise tuberculous cows, only 2 cases out of 13, or milk from otherwise tubercolous cows, only 2 cases out of 13, or a lattle under to per cent, gase positive result. Where the failure to produce tubercolous occurred in the first series, the case of the control of the played an important part in determining the severity and rapidity of the course of the disease, and they stated that their experience accorded with that of other observers, that inoculainto the perstoneal cavity is much more certain than noculation into the subcutaneous listue, especially where the number of bacilli introduced is comparatively small. They are also led to believe, from a number of feeding experiments, that the production of tuberculosis through the introduction of bacilli into the allmentary canal is of still less frequent occurrence into the ailmentary canal is of titll less frequent occurrence than when inoculation is made into the connective tissue. As regards the possibility of the flesh of tuberculous animals setting up tuberculosis, (a) when introduced an mazis, (b) when expressed juice only was exhibited, their experiments went to prove that the juice only did not in most cases contain a sufficient number the juice only did not in most cases contain a sufficient number of bacilit to set up tubertele, even when noncolated most small redents, but from the fact that they have observed tubercular masses in the muncles of the buttoes for furnerculous cattle, it must be accepted that tubercle bacilit may sometimes, though perhaps retry, be present in considerable numbers in this position. Of three cows Mangaleted in one day at one stangther house, when contains the most of these three variables when the contained in new contained to the contained to most of these three variables contained to the conta definant tubercle was found in the muscles of the battock of two naminals; in one of these there was tubercellosis in every organ and part of the body; in the other there were only a few nodies and no stone of the glainst, there was certainly no modiles and not stone of the glainst, there was certainly no manifested. They concluded that there was great necessity for a thorough inspection of both dury cattle and of ammals that were slaughtered for food purposes, but it might be accepted that the danger of contracting tubercle from milk was greater than proportion of cattle affected with tubercellous did there seem to be any danger to be anticipated from the ingestion of the flesh. proportion of cattle affected with tuberculosis did there seem to be any danger to be anticipated from the ingestion of the flesh. In the main they agreed with Prof. Burdon Sanderson and Dr. Bang that there was not yet sufficient evidence on which to decide that the total seizure of meat from tuberculous animals should be resorted to.

Prof. Hamilton, of Aberdeen, said that there were two principal channels of infection, (1) the gastro-intestinal tract, (2) the lungs, but in addition to these whad what ingit he spoken of as localized tubercle, which seemed to be shut off entirely from all communication with the external world (1) In the body the sflection might take place by the sir channels, as in the case an communication with the external words (1) is the body of the color present of the color of th

positive results obtained in which all possible sources of failure could be eliminated. Whilst saving this, he must admit that in the case of children tuberculous material, whether in meat the case of children tuberculous materias, whether as mean or milk, would always prove a very important source of danger. He would draw attention to the disease as it occurred

danger he would draw attention to the disease as it occurred no cuts, on which animals he had made many experiments. Dr. Hume, of Bradford, was glad to find that our foreign frends, who are not hampered as we are in making experiments, agree with us in the main. He thought that we were likely to run wild on the subject of the total sleziare of tubercular meat, run wild on the subject of the total seture of tubercular mear, and he would point out that in no county does a total serure law exist such as it is proposed to adopt here in England. In England he would point out that the inspection is worse than in any other country. He referred to Prof. Lingard's experiments any other country He referred to Prof Lingard's experiments given in an official report, which, he pointed out, spoke only of tubercle being transmitted by caseous material, and not by meat from a tuberculous cow, as was usually assumed We had the authority of Koch himself, said Dr. Hime, that there is danger only when tubercular material itself is ingested. Infection by milk he looked upon as proved, but he would also insist very strongly that the majority of infection in cases of phthisis was directly between man and man, and it was far more important directly between man and man, and it was far more important that we should eliminate possible sources of contagion between that we should eliminate possibilities of infection from animals to man. Dr. Barlow (London), speaking from a clinical point of view, was scarcely able to indone the results of experimental researches, and he manimated that as regards suberculous in

children we must for the present keep our minds open children we must for the present keep our 'minds open. There was no doubt that the post morient in children's hospitals gave evidence of the curronous frequency of toberculosis, but the evidence of the curronous frequency of toberculosis, but the contract of the curron of the curro danger

of. Perroncito, of Turin, referred to a number of experiments Prol. Perroncies, of 1 urns, reterred to a number of experiments that he had carried out with meat, milk, and the products of the latter, and then pointed out that spontaneous tubercle very rarely occurred in the pig, though it might frequently be met with as the result of infection. The same might be said of sheep Here, also, it might occur, though rarely, as the result of direct

Prof Burdon Sanderson, in reply, said he was pleased to find Prol Burdon Sanderson, in reply, said he was pleased to find that the difference of opinion among to amany suffordite was so slight. If was evident that all were agreed that impedies no sa regard the difficulty of diagnosis. He way glid to find that as regard the difficulty of diagnosis. He way glid to find that for total science, except under very well-defined conditions, he had so fir given way as to acknowledge that such meat might after careful conchine by entailed under special restorations. In order nad so far given way as to acknowledge that such meat might after careful cooking be retailed under special restrictions. In order that something definite might come out of this discussion, he proposed that it be minuted that "the etiology of tubercular disease of early infancy (between three mouths and five years)" be referred for discussion at the next Congress

This was seconded by Dr. Septimus Gibbon, and was carried

unanimously

The President said that he had been greatly interested in the discussion, and he hoped that much good should arise therefrom. He was glad to find that there were some animals, such as the

He was glad to find that there were some animals, such as these pand pig, in which pontainous tuberice was never met with, and he hoped that we might eat these in asfery Supercelly appeared to have a great minimum; as regards tuberich, subject of tuberculous.

Dr. Metschnilforf and Dr. Roux, gave a joint paper on the changes that took place in the issues around tuberich bestellin; twa reads by the former, who illustrated his remarks by means of drawings on the black-board, and by microscopic specimes of drawings on the former, who illustrated his remarks by means of drawings on the black-board, and by microscopic speciments. the tubercle bacillus. He could not understand the comparative immunity from tubercle enjoyed by the pericavilim and the stomach. Prof. Nocard, of Paras, did not think that sufficient proof bad as yet been accumulated that ingestion of tubercalous meat. The process of recovery was indicated by the presented coaled give rise to tubercalous in any high proportion of cases; the greater number of supermental cases had give no contentify enjoy of had an indicated by the presence results, and she hold, to convince himself, require to see more justices the supermental cases had give as process of calculations.

Prof. Ehrlich proceeded to give Koch's present views re-garding tuberculin. He said that the results that bub eva-lation is a superior of the professional professional professional pro-lated to the control of the control of the control of the con-trol of the control of the control of the control of the con-trol of the control of the control of the control of the con-trol of the control of the control of the control of the con-trol of the control of the control of the control of the con-trol of the control of the control of the control of the con-trol of the control of the control of the control of the con-trol of the control of the control of the control of the con-trol of the control of the control of the control of the con-trol of the control of the control of the control of the con-trol of the control of the control of the control of the con-trol of the control of the control of the control of the con-trol of the control of the control of the control of the con-trol of the control of the control of the control of the con-trol of the control of the control of the control of the con-trol of the control of the control of the control of the con-trol of the control of the control of the control of the con-trol of the control of the control of the control of the con-trol of the control of the control of the control of the con-trol of the control of the control of the control of the con-trol of the control of the control of the control of the con-trol of the control of the control of the control of the con-trol of the control of the control of the control of the con-trol of the control of the control of the control of the con-trol of the control of t long as possible the specific excitation of the tissues, and not to do away with this, as was the case where large doses were used. Wherever successful results had been obtained they had all been by the use of repeated minute doses of tubercuhn, which all been by the use of repeated minute doses of tubercum, which were only very gradually increased in strength, and it should be specially noted that the pathological signs found as the result of the action of tuberculin were always produced by large doses Prof. Cornil, Dr. Bardach, Dr. Fonnnck, and Prof. Hueppe were agreed that tuberculin was an heroic and dangerous semedy

were sured that tuberculin was an heroc and dangerous remedy about which we as yet knew little, and which was therefore to be looked upon as still being experimented with Italso seemed to be the general opinion that where it was in use there existed a danger of acting up generalization of a tuberculosis that had hitherto been localized

hitherto been localized — The Hard Revented Park William (1994) and the Hard Revented Park Hard Revented Par remedial effect.

The President, summing up, hoped that in time we should all be able to obtain the wonderfully satisfactory results that had been so fully described by Prof. Ehrlich on Dr. Koch's behalf.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions ex-pressed by his correspondents. Nisther can he undertake to return, or to correspond with the variets of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

Rain-gauges.

I po not think that valuable space in your columns should be occupied by rediscussing old questions. I do not wish to say a word in any respect discountions to Mr. Fletcher, whose ability in other subjects has, I understand, been already recognized, but it really would have been better had he read up the subject before writing the remarkable letter which appears in NATURE

for experimental work, spherical, conical, inclined, horizontal, vertical, and tipping funnels have been used, but until the soil of the British Isles can be made to tilt in altitude and rotate in azimuth, so as to meet the path of falling rain, I think that we must adhere to gauges with horizontal mouths as the best representatives of the surface of the earth

G J. SYMONS British Association Reception Room, Cardiff, August 21.

Cloud Heights-Kinematic Method.

In NATURE of April 16 (p. 563), and possibly elsewhere, I am made to speak of the method of determining the heights of clouds at sea used by Finemann and myself as the "abertation method." This was a missomer that I supposed had been corrected. The more proper term is the "kinematic method," since in it we discuss the apparent motions of the clouds considered as the resultant of the tree motions of the Clouds active the contract of the contra This is the term that I have used since May 1890, observer observer 1018 is the term that I have CLEY: and would commend to others CLEY: Weather Bureau, Department of Agriculture, Washington, August 8. CLEVELAND ABBE.

NO. 1139, VOL. 441

THE BRITISH ASSOCIATION

THE Cardiff meeting, if it was not made remark-1 able by any incident of very special importance, was, upon the whole, successful. Several of the addresses delivered by the Presidents of Sections were of exceptional interest, but some were very long, and

we shall not be able to print all of them.

At the first meeting of the General Committee, held on Wednesday, August 19, the report of the Council for 1890-91 was read by Sir Douglas Calton. Dr Gladstone moved a vote of thanks to Prof. Williamson for his long and valuable services as general treasurer, paying a tribute to the manner in which that gentleman had fulfilled his duties. Sir Douglas Galton seconded, and transied nis quues. Sir Douglas Galton seconded, and the resolution was cordially agreed to. Mr. Vernon Harcourt moved, and Sir J Douglass seconded, the appointment of Prof. Arthur Rucker as general treasurer. This motion was also agreed to. At the meeting of the General Committee on Monday, a deputation from Nottingham was introduced The Association was strom rottingnam was introduced the Association was invited by the Mayor and town authorities to visit Nottingham in 1893. It was stated that it was twenty-five years since the Association had visited Nottingham. The invitation was accepted on the motion of Mr Prece It was also unanimously agreed, on the motion of Canon Tristram, to elect Sir A. Geikie as President of the Association, which meets at Edinburgh next year The Association, which meets at Lendungn leav, Year. I he Lord Provost of Edinburgh, the Marquis of Lothan, the Earl of Rosebery, Lord Kingsburgh, Principal Sir William Mur, Prof. Sir Douglas Maclagan, Sir William Turner, Prof. Tait, and Prof. Crum Brown were elected Vice-Presidents for the Edinburgh meeting. Prof. G. F. rresucents for the Edinburgh meeting. Prof G. F. Armstrong, Principal F. Grant Ogilvie, and Mr John Harrison were elected Local Secretaries for the meeting at Edinburgh, and Mr. A. Gillies Smith Local Treasurer A deputation from Edinburgh also attended with reference to the fixing of a date for the Edinburgh meeting. It was stated on behalf of the Town Council that September 28 was favoured as the opening date of the meeting, though August 3 and September 21 were also mentioned as alternative dates. A motion was made to fix August 3, while an amendment was moved for September 12. but as only thuteen voted for the amendment, the original motion was agreed to-that is, the Association will meet at Edinburgh next year on August 3 The general officers were re-elected, and the following gentlegeneral officers were re-elected, and the following gentlemen were elected Members of Council for the ensuing year — Dr W Anderson, Prof Ayrton, Sir B Baker, Hr H W Bates, Prof Darwin, Sir J, N. Douglass, Prof. Edgeworth, Dr J Evans, Prof Frugerald, Sir Archbald Geitie, Mr R T Glaebrook, Profs J W, Judd, Livening, Lodige, Mr W H. Preece, Profs W. Kamsay, Remold, Roberts-Austen, Schafer, Schuster, Sidgwelk, Mr. G. J. Symons, Profs T E. Thorpe, Marshall Ward, Mr C. J. Whitaker, Dr H. Woodward. The following impressions have been recorded by a correspondent :-

CARDIFF, Tuesday Evening.

One of the most prominent features of the Cardiff meeting has undoubtedly been the prevailing bad weather Rain and cold have had their usual depressing results, and may to some extent account for the disappointment which exists among many of those in attendance. The Local Committee have done their best to render the meeting a social success, but the entertainments by the Municipality and the citizens of Cardiff have been of a somewhat restricted character. Notwithhave been of a somewhar restricted character. Notwith-standing, the uppromising state of the weather, the ex-cursions on Saturday and Sunday were largely taken ad-vantage of, and the recoption given by Lord Windsor on the latter day was specially appreciated. The total attendance has been about 1 con, within 200 five Leeds mention, while the amount of money. Sunday the the set is within a few pounds of lany quan. Naturally there has

been considerable talk with reference to the address of the President of Section A, and opinion is divided as to the propriety of introducing the metaphysical into a Section which has emphatically to do with the "solid ground of Nature" On the other hand, Prof Lodge's experiment to test whether the ether is disturbed in the presence of a rapidly-moving body has excited the

greatest interest and admiration.

The soirées at the present meeting can hardly be compared in attractiveness and brilliancy with those held last year in Leeds. Wealthy and populous as Cardiff is, she has not command, apparently, of the scientific and artistic collections which are so creditable to the intelligence and taste of the dingy Yorkshire city. However, the dance taste of the dingy rorsanice city into which to-night's conversations developed evidently conversations of shortcomings. The lectures atoned for a multitude of shortcomings. The lectures have been fairly well attended, Prof. Rucker's beautiful experiments evidently fascinating his audience, in spite of a serious hitch caused by the failure of a steam-engine to do its duty when called upon The discussion, in Section D, as to the relations between animal and plant life was well sustained, and it is a pity that arrangements had not been made to have it fully reported This can be done at very small cost, and the publication of detailed reports of such discussions could not but greatly increase the good they are calculated to do. There is a general belief that inter-Sectional discussions would be of immense advantage in showing the intimate relations which exist between the different branches of science, and in stimulating research in profitable directions. It is probable that several such discussions may be arranged for the next meeting

As usual, Section E had its sensation. A very large audience attended to hear Mrs. French Sheldon describe her journey to Lake Chala, at the base of Kilimanjaro Mrs Sheldon was evidently suffering greatly from her serious accident, and although her address was somewhat disjointed, it contained a good deal of fresh information, especially on the natives, which male travellers have hitherto overlooked. Mrs. Bishop (Miss Isabella L Bird) proved equally attractive in describing her visit to the Bakhtiari country and the Karun River, and, as might have been expected, was somewhat more solid than her less-experienced fellow traveller

The Ordnance Survey formed the subject of an important discussion in Section E, and the Association as a body has resolved to do its utmost to induce Government to introduce reforms. It is fortunate that by the combined action of Sections A, E, and G, a grant of £75

has been obtained for supplying instruments for climato-logical observations in Central Africa.

There was considerable discussion at the general committee meeting vesterday as to the date of the Edinburgh meeting next year. In certain quarters the end of Sep-tember was advocated, but there can be no doubt that the great majority of the working members of the Associa-tion preferred the beginning of August, a date which will suit those connected with the Universities and will catch the citizens of Edinburgh before they leave for their holidays. It is, therefore, not surprising that August 3 has been fixed upon for the Edinburgh meeting, the President of which will be Sir Archibald Geikie Nottingham has

been selected as the place of meeting for 1893.

It is evident that the people of Cardiff are somewhat at a loss what to make of the Association and of the hundreds who are crowding the streets of the town and rushing from one Section room to another. The Sectional secretaries especially, seem to be a puzzle. In the hotel in which they are housed a commercial stock-room has been set apart for their use, with a long baize-covered table down the centre, while to discourage all tendencies to loading, they have been provided with nothing else but

hard kitchen chairs to sit upon.

Altogether, from a scientific point of view, the Cardiff meeting may be said to have come up to a fair average

SECTION D

CHEMISTRY. OPENING ADDRESS BY PROF. W. C ROBERTS AUSTEN, C.B., F R S., PRESIDENT OF THE SECTION.

The selection of Cardiff as a place of meeting of the Brush Association led to the presidency of Section B being intrusted to a metallargata. It will be well, therefore, to deal in this address mainly with considerations connected with the subject to which my life has been devoted, and I hope that it may be possible for me to show that this practical art has both pro-

gifts in return

It is an art for which in this country we have traditional love, nevertheless the modes of teaching it, and its influence on science are but imperfectly understood and appreciated Practical metallurgists are far too apt to think that improvements in their metallurgusts are far too apt to link that improvements in their processes are mainly the result of their own experience and observation, unaided by pure science. On the other hand, those who teach metallurgy often forget that for the present they have not only to give instruction in the method of conducting technique. cal operations, but have truly to educate, by teaching the chemistry of high temperatures, at which ordinary reactions are modified or even reversed, while they have further to deal are moditied or even reversed, while they have further to deal with many phenomena of much importance, which cannot, as yet, be traced to the action of elements in fixed atomic proportions, or in which 'the direct influence of the atom is only beginning to be recognized

The development of a particular art, like that of an organism,

proceeds from its internal activity, it is work which promotes proceeds from its internal activity, it is work which promotes in growth and not the external influence of the environment. It is the property of the process of the environment of the process of the pr

To know Rather consists in opening out a way Whence the unprisoned splendour may escape, I han in effecting entry for a light Supp sed to be without

If it be asked who did most in gaining the industrial treasure and in revealing the light of chemical knowledge, the answer is certainly the metallurgists, whose labours in this respect differ materially from others which have ministered to the welfare of First it may be urged that in no other art have the relations between theory and practice been so close and enduring. Bacon, who never undervalued research, tells us that in the division of the labour of investigation in the New Atlantis there are some "that raise the former discoveries by experiment into greater observations, axioms, and aphorisms these we call the interpreters of nature." There are also others "that bend themselves, looking into the experiments of their fellows and casting about how to draw out of them things of use and practice for man's life and knowledge . . these we call the downy m.n or ben factors" In reviewing the history of metallurgy, especially in our islands, it would seem that the two classes of workers, the in our islands, it would seem that the two classes of workers, the interpreters of nature and the practical men, have for centimes at in joint committee, and, by bringing theoretical speculatin into close connection with hard industrial facts, have "carried us nearer the essence of truth"

The main thenie of this address will therefore be the relation between theory and practice in metallurgy with special reference to the indebtedness of the practical man to the scientific investi-

We will then consider-

(1) Certain facts connected with "oxidation" and "reduc upon which depend operations of special importance to the metallurgist

(2) The influence in metallurgical practice of reactions which are either hmited or reversible.

(3) The means by which i rogress in the metallurgic art may be effected, and the special need for studying the molecular constitution of metals and alloys.

(i) The present year is a memorable one for chemisis, being the centenary of the bursh of Faraday and it he bi-centenary of the death of Robert Boyle. The work of the former has re-cently been lovingly and fittingly dealt with in the Royal Institution, where he inhoused so long. I would, in turn, briefly

400

recall the services of Boyle, not, however, on account of the comcidence of date, but because with him a new era in chemistry began He knew too much about the marvellous action of "traces" of clements on mastes of metal to feel justified in "traces" or elements on masses of metal to feel justified in pronouncing aboutiety against the possibilities of transmitation, but he did splendid service by sweeping away the firm belief that metals consist of subplus, tall, and mecury, and by giving us the definition of an element. He recognized the prepon-derating influence of metallurgy in the early history of science, and quantity tells us that "those addicted to chemistry have and quantity tells us that "those addicted to chemistry have scarce any verse but to the preparation of medicine or to the improvement of metals," a statement which was perfectly cor-rect, for chemistry was built up on a therapeutic as well as a metallurge bass. The fact is, however, this neither the prevait-ration of materials to be employed in healing, nor the study of their section, and anything the the influence on the growth of their section, and anything the section of the study of their section, and anything the section of the study of their section, and the section of the se lurgical processes. Again, strange as it may seem, theoretical chemistry was more directly advanced by observations made in connection with methods of purifying the precious metals, and by the reconstruction of the committee of the control connection with methods of purifying the precious metals, and by the recognition of the quantitative significance of the results, than by the acquisition of facts moderatally gathered in the "grew out of alchemy" nevertheless persuls, and has found expression in this Section of the British Association. As a fact, however, the great metallurgist victacid the search for a trans-position of the properties of the properties of the properties gained for its own sake. George Agricola, the most destinguished of the sixteenth entury metallurgist, in his work. "Do Orts et Causia Subterrancorum" (the v.), written about the year 1536, consist of subtype and mercury, and their precisedes ability to consist of subtype and mercury, and their precisedes ability to consist of sulphur and mercury, and their pretended ability to change silver into gold by the addition of foreign matter.

change silver into gold by the addition of foreign matter. Biringuecio (1546) says, "I am one of those who spore the ear of the additionate enterly. They mock nature when they render imperies to make the properties of the state of the tender imperies to make the properties of the network of the consideration of the wise ancients who strove to obtain possible things." In this time, rescribe the elements meant their destruction and reconstitution; in everthe-ries, his sentence. "transmittation is impossible, because in less, his sentence "transmitation is impossible, because in order to transmite a body you must begin by detroying it altogether," suggests that he realized the great principle of the statement my pitcher by the right handle, for the pseudo-chemists seek gold, but I have the true philosophy, science, which is more precious

precious."
At that cruical period what was Boyle doing when the theory of At that cruical period what was Boyle doing when the theory of At that cruical period when the period to the Balance, and came to the conclasson that the "ponderous parts of finese" could pass through glass to get at melted lead that the state of the period period that the day of the period period that he day to the period that he day to the period that he day to the period to the period that he day to the period to the period to the period that the period to the period review the present state of our knowledge in the light of the inreview the present state of our knowledge in the light of the line suggistion which have been made in the two-centrues that have passed since his own work ceased. If he turned to the end of his fine control parter his death he would see that the failure that the failure of the state of the

burnt the works of Stahl, but it was reserved for the nineteenth

bent the works of Stabl. In it was reserved for the nineteenth contury to reverently gather the abee, recognifing that when the written of the school of Becher spoke of phlogation they means that we understand by potential each effect. Pro Poyl Society had not carried out the Follows of the a "Neposition and to carried out the Follows of the a "Neposition and the College of Section that State of Mines and cause to the Royal College of Section. As well surely thank my collesque, Prof. Driver, for his vigorous defence last year, as Predicted of this Section, of the originality of the work of Prestley and Ceveralth, to which Boyle's own researches had directly left. We no our part, remembed highly the stable prof. centre point round which chemistry revolves," would hope to interest him most by selecting the experiments which arose out of the old metallurgued operation of separating the preclous metals from lead by "capellation." When, in conducting this operation, lead is heated in the presence of air, it becomes con-verted into a very find dross. Boyle had, in 161, taken this operation as the very first illustration in his "Sceptical Chemist" opention as the very fact illustration in hus "Scapical Chemist" in proof of his agginnest as to the elemental nature of metals. He would remember the quantitative work of Gober in the eighth century, who nated that the lead to heater of heater than the properties of the presence of the presence of the presence of capital control of the presence of the presence of capital centure of the presence where he doubtless continued his experiments on calcination, begun some time before, and, as if to mark his interest in the begun some time before, and, as if to mark, his interest in the operation of assyring, figures are represented on a bas-rised on his took in Westmanter Albey as conducting cupellation in a constant of the control of

fluids can freely permeate even solid metals

We may imagine with what vivid interest Boyle would

use an example with what wind interest Boyle would turn, not merely to the results of Priestley's work, but to his methods. Priestley had decomposed lithings with the electric park, and had satisfied himself in 1774, by bearing red inside the control of the satisfied himself in 1774, by bearing red inside the control of the satisfied himself in 1774, by bearing red inside the control of the satisfied himself in 1774, by bearing red inside the control of the satisfied himself in 1774, by the satisfied himself in mination of an atomic weight

mantion of an atomic weight Without of writing his attention from the phenomena of oxidation, Boyle would hid questions the interest of which is only equalled by their present obscurity, or of chemical science, described by Van 1 Hoff as that of its evolution from the descriptive to the rational period, in the early days of which the impossibility of separating physics and chemistry became evident, and so play evoid find that actenistic is now regarded from the point of the property of the control of the property of the control of the point of t

of view of the mechanics of the atom

of view of the mechanics of the atoms. Deville's experiments on dissociation have rendered it possible to extend to the groups of atoms in chemical systems the knowledge over the found seventure of the which govern the found seventure comparable in its importance to that which followed the discovery of the law of definite proportions, for dissociation has shown us that tree causes of desailed and the state of the seventure of t

at a certain critical temperature and pressure the slightest varia-tion of elther will destroy the equilibrium of the system and induce chemical change.

The aim of Boyle's chemical writings was to show that no

The aim of Boyle's chemical writings was to show that so barrier exists between physics and chemistry, and to "serve the commonwealth of learning by begetting a good understanding betwith the chemists and the mechanical philosophers," who had, as he said, "been too great strangers to each other's dis-coveries." In view of the dominant lines of research which coveries." In view of the dominant lines of research which cocupy chemists at the present time, such, for matance, as the investigations of "cosmotic pressure" and of the applications of Boyle's own law to sailt an soliton, be would seek that the book of the part in Berthollet's ducussion with Prossit, he never theless shares Berthollet's ducussion with Prossit, he never theless shares Berthollet's ducussion with Prossit, he never the part in Berthollet's ducussion with Prossit, he never the part in Berthollet's ducussion with Prossit, he never the part in Berthollet's ducussion with Prossit, he never the part in Berthollet's ducussion with Prossit, he never the part in Berthollet's ducussion with Prossit, he never the part is provided by the part of t

We need, however, no longer look at these questions from we need, nowever, no longer look at these questions should the point of view of Boyle, for our own interest in the application of chemical mechanics to metallurgy is sufficiently vivid, as instances to be given subsequently will show.

Higherto I have mainly dwell on questions relating to oxida-

Hitherto I have mainly dwell on questions relating to oxida-tion, but not less interesting is the history of the steep by which an accurate knowledge was acquired of the other great process procused by the melallargust, the one to which Paracelus was the first to apply the name of "reduction". Its explanation followed naturally from the elucation of the phenomena of combustion by Lavouster, who is continuation of Macquer's representant of 1771 proved, in conjunction with other workers, the process of the process of the process of the con-lated or oxygen. Carbon has been known for age as the most important of the reduces access that when it is "23.1 accesses." important of the reducing agents, but when, in 1772, Lavoisier heated oxide of lead and carbon together, he did not at first heated oxide of lead and carbon together, he did not at hist recognize that carbonic anhydride had been produced, simply because the volume of the gas set free was the same as if oxygen merely had been inherated. He soon, however, saw that neither the carbon slone, nor the oxide of lead alone, gave rise to the evolution of carbonic anhydride, which resulted from the the crounted of carroonic annyarine, which resulted from the material action of carroon and a constituent of the litharge. "This last observation leads us intensibly," he adds, "I overy important reflections on the use of carbon in the reduction of media." It most certainly did, and by 1815 an accurate, it meouplete, use of reduction had passed into the encyclopedias. It was seen view of reduction had passed into the encyclopedias. It was seen that the removal of oxygen from burnt metals, by parton, "gives the metals," as Tourcrys and Vasquelia put it, "i new existence" Some ten persi later Le Flay attempted to show that reduction is always effected by the intervention of carbonic mode, within cliented the classical repeated from Cary-Lasses, conde, within cliented the classical repeated from Cary-Lasses, the contract of the contract Intervention of carbonic oxide or of any other clastic fluid." I mention these facts because metallurgists are slow to recognize their indebtedness to investigators, and too often ignore the extreme pains with which an accurate knowledge has been acquired of the principles upon which their processes have been

The importance of a coherent explanation of reduction in smelting pig-iron is enormous. The largest blast-furnaces in 1815 hardly exceeded those in use in the previous century, and were at most only 40 feet high, with a capacity of 5000 cubic feet. At the present day their gigantic successors are sometimes 90 feet high, with a capacity of 25,000 cable feet. This development of the blast-furnace is due to the researches of a number of investigators, among whom you Tunner, Lowthian Bell, and Gruner deserve spacial mention. We are, however, forcibly reminded of the present incompleteness of our knowledge of the chanism of reduction, when we remember that the experiments of H. P. Baker have led us to believe that pure carbon cannot be burnt in perfectly dry and pure oxygen, and therefore that the reducing agent, carbonic oxide, cannot be produced at all

unless moisture be present.

Ludwig Mond, Langer, and Quincke, teach us not only that nickel can separate carbon from carbonic oxide, but the wholly nickel can separate earbon from carbonic oxide, but the wholly unexpected fact that dry carbonic oxide can at a temperature of 100° take up nickel, which it again deposits if heated to 150°. Mond and Quincke, and independently, Bertheidt, have since proved the exitence of the corresponding composed of from and carbonic oxide, and if may safely be concluded that in the blast-furnace smelting iron this preculiar action of carbonic basic plays an important part, and it doubtless alofs the exchination of iron by cementation. It is truly remarkable that the past year should have brought is so great an increase in our knowledge of what has place the state of anything more than "a trace" of an elastic fluid or of any third element. Cannot has further show within the last few months that the action between iron and carbon is a mutual one, for though carbon in the pure diamond form carburizes iron, the metal in its turn, at a temperature of 1050°, attacks the diamond,

invests it with a black layer, and truly unites with it.

The question of the direct carburization of iron (Darby's process) by filtering the molten metal through carbon, promises to be of much importance, for at present, as is well known, two millions of tons of steel which are made in the Bessemer converter in this country alone, are re-carbanized after "the blow"

by the addition of spiegeleisen

by the addition of spiegelaisen.

Carbancoude, moreover, sould appear to be more chemically
active than had been supposed, for during the present part
active than had been supposed, for during the present part
of the present part of the present part of the present part
of the present part of the present part
of the present part of the present part
of the present part of the present part
of the present part of the present part
of the present part of the present part
of the present part
of the present part of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present part
of the present p

(2) In turning to the modern aspects of metallurgical practice. (2) In turning to the modern aspects of metallurgists' practice, we shall see that the whole range of the metallurgist's field of study is changing. It is no longer possible for him to devise a series of operations on the evidence afforded by a set of equations which indicate the completion of an operation, he has, as I which indicate the completion of an operation, he has, as I have already suggested, to consider the complicated problems which have been introduced into chemistry from the sciences of physics and mechanics. He has, in fact, no longer to deal merely with atoms and molecules, but with the influence of mass. merely with atoms and molecules, but with the influence of mass A O standid points out, we are reminded that many chemical processes are reciprocating so that the original products may be opposed processes as a state of CREMICAL EQUILIBRIUM, in which both the original and the newly-formed substances are present in definite quantities that remain the same so long as the conditions, more especially temperature and pressure, do not conditions, more especially temperature and pressure, so not undergo further change. Again, 10 very many metallurgical processes, reactions are rendered incomple e by the limitations imposed by the presence of bodies which cannot be speedily eliminated from the system, and the result may be to greatly retard the completion of an operation. The time has come when the contract of the completion of an operation. The time has come when metallungical problems if they are to be correctly understood, and """ "" "" "" province, necessary, in premither, the rare, instead by the it is, moreover, necessary to remember the part played by the surface separating the different aggregates in contact with one another. When, for instance, a reaction has to take place accomanother. When, for instance, a reaction has to take place accompanied by the evolution of gas, there must be papec into which the gas can pass. The rate, therefore, at which change takes place will obviously depend on the state of division of the must. One of the most remarkable points in the whole range of elements; pashed action engendered between two dements capable of reacting by the presence of a third body. It may be and thus at the most wonderful fact of all, that merely a trace of a third body is necessary to induce reaction, or to profoundly modify the structure of a metal H. Le Chatelier and Mouret incomy the treterite continuents in the Canada and the continuents of have pointed out that in certain cases it is inaccurate to say that

the zinc is sufficient to exert this protecting action on that metal I am satisfied that if our metallurgists are to advance their industrial practice, they must, if I may use such an expression, industrial practice, they must, it I may use such an expression, persistently think in calories, and not merely employ the ordinary atomic "tools of thought." They will then be able to state what reactions can under given conditions, take place, to indicate those which will be completed; and to avoid those that are

402

what factored was the completed; and to avoid those that are impresticable. In France, the courty of so many great metallurgust, men first Le Chatelier and Dite saw doing admirable served, by Deville within the range of practical men. And if I do not refer more specifically to their work it is for wast of space and not of appreciation, but it see winple cases of reversible actions man reducing agent, earbosic codes, is produced from the solid fuel by the rection $CO_2 + C - \pi CO_3$, a reaction which is intervente, and sate either by depolymenting the carbon into a simpler form whoch can comhon with oxygen of the CO₃ with evolution of heat, or by dissociating carbonic and with oxygen of the CO₃ with evolution of heat, or by dissociating carbonic andly of the order of the control of the control of the value of the va

Fe.O. + 3CO = 2Fe + 3CO.

Fe,O₃ + 2CO = 2Fe + 3CO,
But the gas assuing from a blast-furnace contains carbonic oxide, an important source of heat. The view that this loss of carbonic oxide was due to the fact that the consist of heave and the reducing gas was not sufficiently prolonged, led to great increase in the height has the contained of the conta attempt to smelt oxide of zinc in the blast furnace, for which operation patents have frequently been sought, in ignorance or defiance of the readiness with which the inverse action occurs, so that the reducing action of carbon on oxide of zinc may be belanced by the re-oxidation of the reduced zinc by carbonic anhydride, which is the product of the reduction A further in stance may be borrowed from an electro chemical process which has been adopted for obtaining alloys of aluminium. As as well known, all attempts to effect the direct reduction of alumina by carbon have failed, because the reaction

2(Al₂O₂) + 3C = 4Al + 3CO₄

requires 783 2 calories, while only 291 calories would result from the conversion of carbon into carbonic anhydride, therefore the reaction cannot be effected, but in Cowles's process aluminium is nevertheless liberated when slumina is mixed with charcoal and strongly heated by the passage of an electric cur-rent. This result is due, not to a simple reduction of alumina, but so its dis-ociation at the high temperature produced by the assage of a current of 1600 amperes between carbon poles, the liberated aluminium being at once removed from the system by metallic copper, which is simplicaneously present and may not be without action itself.

without action used:

An instance of the importance of these considerations is presented in the manufacture of steel by the basic process. Must care is devoted to obtaining conditions which will insure, not only the elimination, but the order of the disappearance of the only the elumination, but the order of the disappearance of the impurities from the molten poligion. In the bases process as conducted in the closed converier, the phosphorus does not disappear until the carbon has left the fluid buth, white, when the open-hearth furnace is used, the elumination of the and the same that is a same that the carbon post before the phosphorus is got ind of, a further addition of carbon is necessary. A curous and subtle case of chemical equilibrium is here presented. In the open-hearth furnace and Bessems converter respectively, the temperatures and pressures are different, and the conductions as to the presentation of oxygen classifications of the contract of the relative rates of oxidation of the phosphorus and carbon are different in the two cases, although in either case, with a given

method of solving, here must be a ratio between the phenomenon of the question is very remarkable. In the basic Beavers process the tendency of the phonophorus to longer is the bath renders an "after-blow" more supported by the phenomenon of the

of steel would be effected annually, the value of which, at the present rate of output and price of steel, is no less than a quarter of a million sterling.

The volatulization of sulphur in the converter while it is tauned by the steel in the open-hearth furnace, and the increase m the percentage of manganese which leaves the slag and "thlow," will probably be traced to the disturbance of equili-brium which attends very slight variations in the conditions, especially as regards temperature and pressure, under which the operations are conducted

In the blast-furnace the reducing action must be greatly de-pendent on the rate at which alkaline cyanides are formed, and Hempel has recently shown, by the aid of well-devised experiments, that the quantity of cyanides which may be obtained at a high temperature from carbon, nitrogen, and alkaline oxides,

a high temperature from carbon, nitrogen, and alkaline ounder, increases at the pressure become graperial branch of the must Metallingted chemistry is, in fact, as practical branch of chemical behavior of the properties of the ordinary sphere of the acadence teaching of chemistry. It is often seged that metallargical practice depends upon the application of chemical principles which are well study in every large centre of instruction in this country, but a long series of chemical reactions exist which are of visit importance to the metallargiar, though they which are or vital importance to the metallargial, though they are not set forth in any British minual of chemistry, nor are dealt with in courses of purely chemical lectures. If feel bound to must upon this point, because, as Examiner Metallargy for the Science and Art Deportment, I find that purely analytical and laboratory methods are so often given in the belief that they are applicable to processes conducted on a large seale, and at

high temperatures.
We are told that technical instruction should be kept apart from scientific education, which consists in preparing the student rrom scientific cuscation, which consists in preparing the student to apply the results of past experience in dealing with entirely new sets of conditions, but it can be shown that there is a whole side of metallurgical teaching which is truly educational, and leads students to acquire the habit of scientific thought as surely

reads students to fought re the name of scientine thought as surely as the investigation of any other hranch of knowledge. It is, in fast, haddly possible in a course of theoretical chemistry to devote much attention to specific cases of industrial practice in which reactions are incomplete, because they are limited by the presence of bodies that cannot be directly eliminated from the chemical system Take, for instance, the long series of reactions studied by Platitier, who published the results of his investigations in his celebrated treatise, "Die Metallurgische Rostprozesse," Freiberg, 1856, whose work I have chosen as a starting-point on account of our presence in South Wales near the great copper-suching district of Swanses. A complex sulphide, of which copper is the main metallic constituent, contains some fifty ounces of allver to the ton. The problem may be supposed for the present to be limited to the hidden, and the student deriving his knowledge from an ex-cellent modern chemical treatise would find the case thus

"Ziervogel's process depends upon the fact that when argentiferous copper pyrites is roasted, the copper and iron sulphides are converted into insoluble oxides, whilst the silver is converted into insoluble oxides, whilst the silver is converted into a soluble sulphate, which is dissolved out by lixivating the roasted ore with hot water, the silver being readily precipitated from this solution in the metallic siler. from this solution in the metallic state.

from this solution in the metallic state."
It is errain that if an observing exposured in model in the little of t

the bed of a rewrberstory furnace. Suppose the material la what is known as a complex regulan, as imported into Swanser or produced at Freeberg, to which are added rich nature sulphides. The mitures then consists of subplides manify of iron and copper, with some sulphide of lead, and contains fifty or astroyonces of allere to the ton, and see grams of gold. It may also contain small quantities of arsenic and antimorneys a method, and mittonoides, and sulpho salts, usually with copper as a base

also contain small quantities of arsenic and antimony as arsenides, antimonodes, and sulpho salts, usually with copper as a base. The temperature of the furnace in which the operation is to be performed is gradually raised, the atmosphere being an oxidizing one. The first effect of the elevation of the temperadising one. The first enect of the cleration of the composi-ture is to distil off sulphur, reducing the sulphides to a lower stage of sulphurization. This sulphur burns in the furnace atmosphere to sulphurous anhydride (SO₂), and, coming in consatisfact with the material undergoing oxidation, is converted into sulphurie anhydride (SO₂). It should be noted that the material of the brickwork does not intervene in the resations, except by its presence as a hot porous mass, but its influence is, nevertheless, considerable. The roasting of the sulphides presents a good case for the study of chemical equilibrium. As soon as the sulphiurous anhydride reaches a certain tension, the oxidation of the sulphide is a rested, even though an excess of oxygen he present, and the oxidation is not resumed until the action of the draught changes the conditions of the atmosphere of the furnace, when the lower sulphides remaining atmosphere of the furnace, when the lower sulphides remnaining are slowly oxidized, the copper sulphide being converted into copper sulphase being converted into copper sulphase mainly by the intervention of the sulphine analydride formed as indicated. Probably by far the greater part of the floor aulphide only becomes sulphase for a very brief period, heing decomposed into the oxides of iron, mainly ferric period, heing decomposed into the oxides of iron, mainly ferric oxide, the sulphur passing off. Any silver sulphide that is present would have been converted into metallic silver at the outset were it not for the simultaneous presence of other sulphides, notably those of copper and of iron, which enables the silver sulphide to become converted into sulphate. The lead sulphide is also converted into sulphate at this low temperature The heat is now raised still further with a view to split up the salphate of copper, the decomposition of which leaves oxide of er If, as in this case, the bases are weak, the sulphuric copper If, as in this case, the bases are weak, the sulphates of anhydrice escapes mainly as such; but when the sulphates of stronger bases are decomposed, the sulphuric anhydride is to a great extent decomposed into a mixture of sulphurous anhydride and oxigen The sulphuric anhydride, resulting from the de-composition of this copper sulphate, converts the silver into composition of this copper suppante, converts the silver mu-sulphate, and maintains it as such, just as, in turn, at a lower temperature, the copper itself had been maintained in the form of sulphate by the sulphure analydride eliminated from the ron sulphide. When only a little of the copper sulphate remain undecomposed, the silver sulphate begins to split up, and the furnace charge must therefore be immediately withdrawn, or the whole of the silver sulphate would be converted into metallic silver, partly by the direct action of heat alone and partly by reactions such as those shown in the following equations --

$$Ag_{8}SO_{4} + 4Fe_{8}O_{4} = 2Ag + 6Fe_{8}O_{8} + SO_{2},$$
 $Ag_{8}SO_{4} + Cu_{8}O = 2Ag + CuSO_{4} + CuO.$

If the charge were not withdrawn, the silver would thus be effectually removed from the solvent action of water, and the smelter's efforts would have failed entirely. The charge still contains lead subjuste, which cannot be completely decomposed at any temperature attinuable in the rosting furnace, except in evidence to the control of the series of the control of

Sh₂S₂ + 3H₄ = 3H₄S + 2Sb between hydrogen and sulphide of antimony is, however, endothermic, and could not, therefore, take place without the aid

which is afforded by external heat. The facts appear to be as follows: subjide of antimony, when beated, discourtes, and the tension of the sulphus vapour would produce a state of equilibrium if the sulphus thus biderated were not seited by the hydrogen and removed from the system. The equilibrium is thus destroyed, and fresh sulphus is discounted; the general result being that the equilibrium of the system is continually restored and destroyed until the sulphus is decomposed. The restored and extremy during the sulphus is recognized, as do as does also the ancein; a portion of which is volatilized as sulphuse.

The man object of the process which has been convidered in the formation of soluble sulphate of uters. If a renel is and animony have not been eliminated, their presence at the end of the operation would be specially motionevenent, as they gave rue to the formation of arkinate and antimomate of silver, insoluble in water, which may necessitate the treatment of the residues by an entirely different process from that which has hitherto been considered.

It will have been ewdent that effecting this sense of changed demands the exercise of the utnot skill, care, and patence. The operations beginning at a dull red heat, or a temperature of men god, are completed at you, which a range, that is, of 200 of emats of subplicates, which would impose the reactions, and as has been shown, an undue elevation of temperature of emitted range would, at any singe, have been fault to the telescape of sight and touch which enables an operator to judge by the end of rough tests, but mainly from the tint of the telescape of sight and touch which enables an operator to judge by the end of rough tests, but mainly from the tint of the telescape of sight and touch which enables an operator to judge by the end of rough tests, but mainly from the tint of the return of the sight of the si

Proceeding yet one use further, suppose that the cooperineller takes possession of the rendail mass, consuiting manily of outset of copper, he would smelt it with fresh adjubide ore, reconstitutes containing some mall proportion of copper. The duplacement of the copper from this allecte may be effected by fissing in with subjuble of iron, a fasible subjuble of rone and copper being formed, which restally separates from the size, anded to the world's annual production. Proceeding yet a step further, suppose the amelier to have redused his copper to the metaller state. If arments had been originally present in the metaller state. If arments had been originally present in the process, in extracting small quantities of arments which result he smeller! efforts. Copper, noteoner, containing arrenic chinatics of gases on the presence of settings of the test of the second presence of the copper, and would be fast to its use in submarine telegraphy. If you the other hand, the copper-smeller has to remove may very from mere traces up to a presence of the copper, and would be fast to its use in submarine telegraphy. If you the other hand, the copper lamended for the maker of locomother dise-boses, increase the jetterical treatance of the copper, and would be fast to its use in submarine telegraphy. If you the other hand, the meller will list need a case have no indecement to employ the basic featured lining which Mr Gilbritist has offered bim, nor will be case but the precial methods for the removed of amenic with which he is familiar. It may all seem simple enough, but the modern process of copper-smelling has been laborically built up, and has a long and increasing pedigree which may be traced to at least the eighth century, when Gaber described the regulu, "coare metal," as being "of a most clean and plea-sure to the companies of the metal and the companies of the com-summent of the companies of the companies of the companies of the sant violet colour," and indicated the reason for the difference.

404

(3) The foregoing Instances have been given to indicate the general nature of metallurgical chemistry. It will be well now to show how the great advances in metallurgical practice have been made in the past, with a view to accertain what principles should guide us in the future.

been made in the past, with a view to ascertain what principles should guide us in the fature.

It is a grave mistake to suppose that is industry, way some should guide us in the fature.

It is a grave mistake to suppose that in judicity, way some produced of a master possessed of some new girl of invention; yet we have been reminded that we are apt to be rewrected to these alone, as it the nation had been unprogressive and suddent whether the suppose of the production of the suppose of the production of the suppose of the production of the production. Whether the investigators are few or many, and consequently whether progress is suffered to the production of parts such case. Whether the investigators are few or many, and consequently whether progress is suffered to the production of the production. Whether the investigators are few or many, and consequently whether progress is allow or rapid, will depend no nonline sustained to whether the production of the production

precedent, but it should be remembered that though the few successes, which have been attained in the course of ignorant practice, may come into prominence, none of the countless failures are seen. I would briefly direct attention to certain processes which have

failures are seen.

I would briefly direct attention to certain processes which have been adopted since the year 1849, when Dr. Percy preseded over the processes of the process

It must not be supposed that when commercially part capter has on the transce but may be be structured to could, that his principles covery of restrictions overy. It might be thought that the few turnle per count, of instances the contractions covery in the contraction of the country of the

process had been prepared by the theoretical work of Andrews, 1245, and of Favre and Silbermann, 1852, whose work on the calonific power of various elements showed that silicon and phosphorus might be utilized as fuel, because great heat is engendered by their combestion.

by their combustion.

The basic process for removing phosphorus, a process of great national importance, the development of which we owe to Thomas and Guichrist, a neutrey the outcome of purely theoretical teaching, in connection with which the names of Griner and Percy deserve special mention. In the other great group of processes for the production of steet, those in which Stremnis's of processes for the production of steet, those in which Summers a regenerative furnace is employed, we have the direct influence of a highly trained theorist, who concluded his address as Pre-sident of this Association in 1882 by reminding us that "in the great workshop of Nature there is no line of demarcation to be drawn between the most exaited speculation and commonplace practice." The recent introduction of the method of heating by radiation u, of course, the result of purely theoretical con-

The progress in the methods of extracting the precious metals The progress in the methods of extracting the precious metals bacter very great, both on the chemical and engineering sides, but it is cursous that in the metallargy of gold and silver, many ancent processes survived which were surveed as emplrically—for the contract of the contract of

while chievide of silver is being formed.

The influence of scientific investigation is, however, more evident in that portion of the metallurgic art which deals with the adaptation of metals for use, rather than with their actual extraction from the ores.

Only sixteen years ago Sir Nathaniel Barnaby, then Director Only sixtem years ago Sir Nathanuel Barnaby, then Director of Naval Construction, wrote, "Or distrust of seal to se great that the material may be said to be aitogether tunned by private that the material may be said to be aitogether tunned by private that the material may be said to be aitogether tunned by private the said of t

were being built of steel in the United Kingdom. Why is it, then, that steel has become the material on which we rely for our ships and for our national defence, and of which we have a spindial structure as the forth Bridge is contracted? It is because, slide by side with great improvement in the quality it is because, slide by side with great improvement in the quality heart process, elaborate researches have shown that is the most suitable mechanical and thermal treatment for the meeting but the adaptation of seel for industrial use is only typical, as the innerest in this branch of metallurgy generally appears for the motions to be centred in the question whether meetia can, mechanical stress from a normal state to an allotropic one, or whether meetia metange even the motion to be desired. whether metals may even exist in numerous isomeric states.

whether metais may even exist in numerous isomeric states. It is impossible to deal historically with the subject now, further than by stating that the belief of more than one "modification" is old and widespread, and was expressed by Paracelism, who thought that copper "contains in itself its female," which could is old and widespread, and was expressed by Farsecisia, who thought hat copper "contains in litell its female, "which could fusion and malleability" as steel and iron differ. Within the last few years Soltiumsberger has shown that two modifications of copper can exast, the normal one having a density of 8 of, while that of the alteropic medification is only 80, and is sellowed the solitonian contribution in one of the solitonian contribution on ordinary copper. It may be added that Lard Rayleth's pick not the investigation of the sumpler chemical reactions has been partly me, in the case of coppor, by the experiments conducted by 1½. Velyo on the conditions of chemical change conducted the sellowing the conditions of the conditions of the sellowing the conditions of the sellowing the sellowing the conditions of the sellowing the s

fead-tin alloys polymerization may take piace after the alloys have become solid, and it seems to be admitted that the same save the course fold, and it seems to be desirted that the sare cases underlied both polymerisation and allorropy. The pheno-menon of allorropy is dependent upon the number of the atoms neach molecule, but we are at present far from being able to any what degree of importance is to be attached to the relative distance between the stoms of a meal of to the "politic of one alloyed or free, and it must be admitted that in this respect organic chemistry as far in dwance of metallurgic chemistry. I cannot, as yet, state what is the atomic grouping in the brilliantly-coloured gold-alminium alloy. And, which I have had the good fortune to discover, but, in it, the gold is probably present maintains.

Much valuable information on the important question of allotropy in metals has already been gathered by Pionchon, Ditte, Moissan, Le Chateller, and Osmond, but reference can only be made to the work of the two latter. Le Chateller concludes that in metals which do not undergo molecular transformation the dectars which to the most endergo molecular transformation the clectrical resistance increases proportionally to the temperature. The same law holds good for other metals at temperatures above that at which their last change takes place. For example, in the case of nuclei above 340°, and in that of iron above 850°. It is probable that minute quantities of foreign matter, which

profoundly modify the structure of masses of metal, also induce altoropic changes. In the case of the remarkable action of importate upon pure gold I have auggested that the modifications which are gold and the sease of the specific variations which are produced may have direct connection with the periodic law of Meeticlesff, and that the causes of the specific variations of the second of the sease of the specific variations of the sease of the specific variations of the sease of the specific variation is of great industrial importance, aspecially in the case of iron is and Comond, whose secletient work I have already brought before the members of this Association is a fecture of the sease as the sease of the allotropic changes. In the case of the remarkable action of imthan that of iron tend to hasten the change of β to α iron. It is, however, unnecessary to dwell upon this subject, as it was dealt with last year in the address of the President of the

Association.
It may be added that the recent use of nickel-steel for armouphate, and the advocacy of the use of copper-ateel for certain purposes, it the industrial justification of my own views as to the influence of the atomic volume of an added element on the mechanical properties of rose, and it is remarkable that the two bodies, silicon and aluminame, the properties of which when in a five state are so totally different, should, nevertheless, when a five state are so totally different, about, not a same way. Silicon and aluminame have allowed the state of the state

and aliminium next amost the rame atomit volumes. The consequences of allotropic changes which result in alteration of structure are very great. The case of the tin regimental buttons which fell into a shapeless heap when exposed to the rigorous winter at St. Petersburg, is well known. The recent remarkable discovery by Hopkinson of the changes poses to the regroup winder at St. Peterbourg, a well known in the density of includence and the state of the

The molecular behaviour of alloys is indeed most interesting. W. Spring has shown, in a long series of investigations, that

alloys may be foresed at the ordinary temperature, provided that manute particles of the constituent metals are submitted to great the constituent metals are submitted to great favour of the two that an alloy can be produced from its constituent metals with but slight pressure if the temperature to which the mass is submitted be above the mening-point of the easily faults constituent. A further nature at thus afforded of the fact that a variation of either temperature or pressure will effect the unson of solids. It may be added that B. C. Damies of the conference of an interesting relation between the conference of an interesting relation between the conference of an interesting relation between the conference of the conference of an interesting relation between the conference of the conference of an interesting relation between the conference of the conference of an interesting relation between the conference of the conference of an interesting relation between the conference of the conference of an interesting relation between the conference of the conference of an interesting relation between the conference of the conference atomic weight of metals.

Few questions are more important than the measurement of very high temperatures Within the last few years H Le Chateller has given us a thermo-counte of platinum with platinum containing to per cent. of rhodium, by the aid of which the problem of the measurement of high temperatures has been problem of the measurement of bign temperatures has been greatly simplified. A trustworthy pyrometer is now at band for daily use in works, and the liberality of the Institution of Mechanical Engineers has enabled me to conduct an investigation which has resulted in the adoption of a simple appliance tion which has resulted in the adoption of a supple appliance for obtaining, in the form of curves, photographic records of the cooling of masses of metal A report on the subject has already been submitted to a Committee, of which the Director-General of Ordinance Factories is the Chairman; and Dr. Anderson, to whom I aim indebted for valuable assistance and derice, intends to add this new method for obtaining sattographe curves of pyrometroe measurements to the numerous self-recording appliances used in the Government factories which he controls. It has proved to be easy to ascertain, by the add of this pyroutlets makes the control of the properties of the p whom I am indebted for valuable assistance and advice, intends

Prof. H. E. Armstrong holds that the molecules of a metal can mate to form complexes with powers of coherence which vary with the presence of impurity. Crookes, by a recent beautiful investigation, has taught as now electrical evaporation as alloy mass, by form the property of the prop

the molecular contribution of metals, I would specially refer to the excellent work of Heyocck and Nevella, who have excessed on the effect of Impority on the Investment of the State of State

investigations conducted at the Watertown-Aremal, Maschuetta, not to mention the numerous Conlineatal testing laboratories directed by such men as Bauschinger, Jenny, and Tetmajer. Perhaps the most important recent work is that described by Prof. Martens, of Berlin, on the influence of heat on the strength of tron

I must have duel at length on all these mattern without often Ball his service to mediturely that I loop to reader by earnerly pleading for the more extended teaching of the subject throughout the country, and for better laboratories, arranged on the model of engineering laboratories, in which the teaching is the model of engineering laboratories, in which the teaching is reconcluded with the aid of complete, though sealily "plant." The Sceneos and Art Department has done great and lasting secret by directing that made with regard to laboratories in works, which are too often mere theids placed, say, behind the boller-house, when may we hope to rival the German chemical firm which has recently spent £19,000 upon its laboratories in which research will be vigorously goodwated? There is hardly any breach of morphic chemistry back of the place of the sum of the properties of the sum of the properties of the union timportance to him.

mechanics are of the utmost importance to him. The wide range of study upon which a metallurgical student is rightly expected to enter is leading, it is to be feared, to the control of the student of t

prefereice for chemists who have been trained in works, to those who have been quicated in a college inboratory.

In making and metallurgy, with a view to the full development of the mineral wealth of a stollar, in well known. The issues at stake are as vast, that in this country it was considered destrable to provide a centre of instanction in which the reaching of mining said are into the contraction of the contraction of the contraction of the Covernment. With this end in view, the Royal School of Mines was founded in 1854, and has supplied a body of well-stake of the Covernment. With this end in view, the Royal School of Mines was founded in 1854, and has supplied a body of well-stake of the Covernment. With this entire the view of the Covernment of the Covernment has recently takens a step in a vivance, and has further recognized the national importance of the teaching of mining and metallargy by directing that the School of Mines shall be incorporated with the Royal College of the teaching of mining and metallargy by directing that the School of Mines shall be incorporated with the Royal College of the teaching of the believe, discusted to lead the securities cutter.

It is to be feared that as regards metalliferous mining our country has veen it best days, but the extraordinary mineral wealth of our colonies has recently been admirably described by end of the extraordinary metal delivered early in the present year on his appointment to the chair so long held by Sir Warington Swith (Lenguezering, oil. i, p. 20 of test). We shall, however, be able to rightly is opened next year, and the nation will have reason to be grateful to Sir Frederick Abel for hear he is development of this great minimum, which will become the development of this great minimum, which will become the resources, as well as a centre of information.

The rayed growth of technical literature renders it unnecessary for a President of a Section to devote his address to recording the progress of the subject he represents. As regards the most important part of our national installary, this has, moreover, been admirably done by successive Primarents of the references would have been made to the unit processes which have been adopted since Percy occupied this chair in 1859. I have not done to, because an assumention of the processes would have been wholly inadequate, and a description of them when the processes would have been wholly inadequate, and a description of them may be well to remusafful Section of sive of the more promisent additions the art has releved in the last half century, and to offer a few statements to daw the magnitude on which operations are

conducted. As regards uno, in the last twenty-five years the price of sized his been reduced from £5 per ton 0.6 per ton, but, after giving the world the inestimable boson of cheeps steel by the known of Essemer and of Senemes, we were somewhat slow to accept the teaching of experiment as to the best method of treating the error material, on the other hand, Haffield has of the mannfacturer, and J. Kiley has done much to develop the use of nuclei-testing the error.

In the case of copper, we have mainly contributed to the extraordinary development of wet processes for its extraction from poor sulphides, and have met the great demands for pure metal by the wide adoption of electrolytic processes.

"An event and processor metals, in contary a well to the front, or force Britain and her colones produce about 3g per cent. of the gold supply of the world, and it may be well toadd, as an andsaxton of the seale on which operations are conducted, that in London alone one to gold and five tons of silver builloon per perfecting the method of sasay by which the value of gold and silver as atcertained, and during my twenty years' connection with the Kopyl Mint I have been responsible for the accuracy of the standard insenses of no less than twe handred and fifty-few handred thousand pounds stering. In the case of the plantom industry we owe its extraordinary development to the skill and maderal thousand pounds stering. In the case of the plantom industry we owe its extraordinary development to the skill and energyine of successive members of the firm of Johnson, Matthey, the contemps of successive members of the firm of Johnson, Matthey, the contemps of the state of the material dealt with may be galacted from the statement that two and a half handred the state of the state of the material dealt with may be galacted from the statement that two and a half handred the state of the state of the material dealt with may be galacted from the statement that two and a half handred the state of the material dealt with may be galacted from the statement that two and a half handred the state of the state of the material dealt with may be galacted from the statement that two and a half handred the statement that we would be statement that we contain the statement when the contains the statement of the contains the statement of the statement of

I with a were possible to record the services of those who have advanced mentalizary in connection with that Association, but the hunsations of twice render it difficult to do more than to have advanced mentalizary in connection with that Association, but the hunsations of twice render it difficult to do more than to which the property of the prope

In drawing this address to a close. I would point to the great In drawing this address to a close, I would point to the great importance of extending the use of the less known meats, importance of extending the control of the control be a rapid increase in the number of metalingical processes that depend on reactions which are set up by submitting chemical systems to electric stress. Incidental reference should be made to the growing importance of sodium, not only in cheapening the production of sluminium, but as a powerful weapon of research. In 1849, when Percy was President of this Section, magnesium was a curiosity; now its production constitutes a considerable industry. We may confidently expect to see barium and calcium produced on a large scale as soon as their utility has and calcium produced on a sarge scale as soon as men unity may beendemonstrated hyresearch Minerals containing molybdenum are not rare; and the metal could probably be produced as cheaply as tin if a use were to be found for it. The quantities of vanadium and thallium which are available are also far from inconsiderable; but we as yet know little of the action of any of these metals when alloyed with others which are in daily use.

The field for investigation is vast indeed, for it must be remem-In eneigh for investigation is vast indeed, for it must be remembered that valuable qualities may be conferred on a mass of metal by a very small quantity of another element. The useful qualities imparted to platinum by iridium are well known. A small quantity of tellurium obliterates the crystalline structure of bis quantity of tellurum obliterates the crystaline structure of but must; but we have lost an ancient art, which enabled brittle must; but we have lost an scient art, which enable brittle statement of the statemen organic compounds, in order to rate alloys from the obscurity in which they are at present left.

It must not be forgotten that metallurgical enterprise rests on a scientific knowledge, (2) capital, and (3) labour, and that, if the results of industrial operations are to prove renumerative, much must depend on the relation of these three elements, though it is difficult to determine accurately their relative importance. A modern ironoworks may have an army of thousand workmen, and commercial success of failure will de tnousance workment, and commercial success or fainte will de pend in so small measure on the method adopted in organizing much interest at the present time that I do not heatate to offer a few words on the subject.

Many examples might be borrowed from metallurgical enter-prises in this and other countries to show, that their nature is

prises in this and other consistent to show that their nature is often presented by what appear to be comparatively slight causes. Capitalists amply appear to be comparatively slight causes. Capitalists amply the consistency of the comparative slight causes. It is not the consistency capitalists are capitalists and the tabloring causes the notation would then severely suffer. It is only reasonable, therefore, that if capitalists are exposed to great risks, they should, on the event of ancoess, receive the greater part of the profix-free is a welepsed feeling that the interests of capital said There is a wedespread feeling that the interests of capital and abour must be susquanticle, and as it is impossible to ignore abour must be susquanticle, and as it is impossible to ignore apprehension, it becomes the duty of all who possess influence to strive not merryl for peace, but to range themselves on the side of justice and humanity. The great labour question can-vered the susquantial properties of the susquantial pro-served to the susquantial properties of the susquantial conversible must be held invisiblely but it must be admitted that there was a time when capital had become arbitrary, and some still of unrel as a susquantial problems of the susquantial pro-tained that the susquantial problems of the susquantial pro-tained in the susquantial problems. self-defence. If, however, we turn to the action of the leaders of trades unions in the recent lamentable strikes, we are pre-sented with a picture which many of us can only view as that of

tyranny of the most close and oppressive kind, in which indi-vidual freedom cannot even be recognized. There are hundrels of owners of works who long to devote themselves to the true welfare of those they employ, but who can do little against the inflaence of the professional against, and are merely saddened by contact with prejudice and ignorance. by correct that some system by which the workman participates in the profits of enterprise will afford the most hope of putting an end to labour disputes, and we are told that profit-sharing tends to destroy the workmen's sense of social exclusion from the capitalistic board, and contents him by elevating him from the capitalistic noard, and contents him by elevating him from the preacrious position of a hired labourier. No pains should, therefore, be spared in perfecting a system of profit-sharing. Pensions for long service are great aids to patience and fidelity, and very much may be hoped from the fact that strengous efforts

are being made by men really competent to lead. The Report of the Labour Commission which is now sitting will be looked for with keen interest Watchful care over the health, interests, and instruction of the employed is exercised by many owners of works; and in this respect the Dowlals Works, which are being transplanted into your midst at Cardiff, have long presented a transplanted into your min's at Caraiti, nave long presented a noteworthy example. Workmen must not forget that the choice of their own leaders is in their own hands, and on this the future mainly depends. "We may lay it down as a perpetual law that workmen's associations should be so organized and governed as to furnish the best and most suitable means for attaining what is aimed at-that is to say, for helping each indiattaining what is aimed at—that is to say, for helping each individual member to better his condition to the utmost in body, mind, and property. These words will be found in the Engy-clical Letter which Pope Leo XIII, has recently issued on the "Condition of Labour." To me it is specially interesting that the Bishop of Rome in his foruble appeal again and again cites the opinion of St. Thomas Aquinas, who was a learned chemist as well as a theologian

Those of us who realize that "the higher mysteries of being, Those of us who realize that "the higher mysteries of being, if penetrable at all by human intellect, require other weapons than those of calculation and experiment," should be fully sensible of our individual responsibility. Seeing that the study of the relations between capital and labour involves the consideration of the complex problems of customes, the solution of which is at present hidden from us, we shall feel with Andrew Lamp that "where, as matter of sciences, we know mobiling, we can only write the message of our temperature?" Say one of the consideration of vent them from driving our national industries from these shores and I would ask those to whom the direction of the metallurrical and I would ask those to whom the direction of the metalitrigical works of this country is confided to remember that we have to deal both with metals and with men, and have reason to be grateful to all who extend the boundaries, not only of our knowledge, but also of our sympathy

SECTION D

Blut ogy.

OPENING ADDRESS BY FRANCIS DARWIN, M.A., M B., FRS., FELLOW OF CHRIST'S COLLEGE, CAMBRIDGE, PRESIDENT OF THE SECTION.

On Growth-curvatures in Plants.

A SERDINO plant, such as a rough sunflower, when growing in a wate of nature, grows straight up towards the open sky, while its main root grows straight up towards the open sky, while its main root grows straight down towards the center of the earth. When it is artificially displaced, for instance by jump the however poor into such soon troot and when execute certain curvatures by the straight of the property of the straight of the property of the straight o Curvatures such as these, whether executed in relation to light, agrivation, or other inflaences, may be grouped together as growth-curvatures, and at is with the history of our knowledge on this subject that I shall be occupied to-day, or the subject of the subject to the subject to the subject to gravitation, but the phenomens in question form a natural growp, and at will be necessary to refer to helitoripian, and, nideed, to other growth-curvatures. The listory of the misject till relation two branches, which it will be consentent to

subject tritices must be obtained; study separately When a displaced apogeotropic organ curves so as to become once more vertical, two distinct questions arise, which may be briefly expressed thus:—

(1) How does the plant recognize the vertical line; how does it know where the centre of the earth is? (2) In what way are the curvatures which bring it into the vertical ine executed?

408

The first is a question of irritability, the second of the mechan-The first is a question of irritability, the second of the mechanism of movement. Sachs has well politiced out that these two more properties of the propert

The history of our modern knowledge of geotropism may conveniently begin with Hofmeister's researches, because in an veniently begin with itomesser's researches, because in an account of his work some of the points which re-occur in recent controversy are touched, and also because in studying his work the necessity of dividing the subject into the two abovenamed headings, Irritability and Mechanism, will be more

named headings, Irritability and Mechanism, will be more clearly perceived.

In 180 (Merchiel, b. Eiche, Ger. d. Witz.), Mefendere In 180 (Merchiel, b. Eiche, Ger. d. Witz.), Mefendere State of the Merchiel of State of Merchiel of State When the shoot comes to restrict to be no longer straight, but to have soquired a permanent beed towards the sade on which it was struck. In explaining this phenomenon Hofmeit-eric described these conditions of growth which give rise to what is known as the tension of issues, these facts are still an important part of botanical study, though they hold quite a different position from that assigned to them by Hofmeister. The classification into active or erecule time and passively extended tissue was then first made. The pith, which passively extended tissue was used use made. In epits, which is compressed, and strives to become longer, is the active or erectile part, the cortical and vascular constituents being passively extended by the active tissue. Hosmeister showed that when the shoot is volently bent the elasticity of the pa-site tons were the shoot is violently own; the elasticity of the pa-silve tissue on the course and is I injured by overstretching. The system must assume a new position of equilibrium, the passive tissues are now no longer equally resisting on the two sides, and the shoot must necessarily assume a curvature towards that aide on which passive tissues are most reassing.

In a second paper, in 1860, Hofme aler (Beruhted k. Sachs. Get d. Wiss.) applied these principles to the explanation of geotropism. It is true that in his second paper he does not refer to the former one, but I think that it can hardly be doubted that the knowledge which supplied the material for his paper of 1859 suggested the theory set forth in 1860. He had shown that in the system of tensions existing in a turgescent shown that in the system of tensions existing in a turgescent shoot lay the power of producing artificial curvatures, and he applied the same principle to the natural curvatures. When an apposperitype copies in placed in a houtonial position, if foresister resisting, so that they yielded more resisting to the proper side to the longitudinal pressure of the turgescent pith. The ystem in such a case comes to rest in a new position, the boot curving upwards, the passive tissues on the upper and lower sides once more resus the expansion of the pith in equal to the property of the property as far as mechanism is concerned, is in rough outline practically the same as certain modern theories, which will be discussed in

the sequel. His views resembled more modern theories in this, too: I clearly recognized that they were, metatis metandis, applicable to acellular organs. The manner in which Hofmeister compared the mechanics of multicallular and acellular parts was pared the mechanics of multicaturs and accituar parts was currous; nowakays we compare the integescent pith of a growing shoot with the hydrostatic pressure inside the sociliate organ. Just as the pressure inside a single cell stretches the cell-walla, so in a growing shoot the turgescent pith stretches the cortex.

⁴ Kn ght had previously suggested an explanation (Philosophical renections, 1805), which is so far smiller, that the susking downwards by ravitation of the judges of the plant is supposed to be the prenary cause of pogeoti-pusm Knight's explanation of positive geotropism is practically he same as Hofenester's pogeotropum Knight's explanation of positive geotropum is practically to same as Hofmenster's "Sache's term acellular is, in the present connection, equivalent to succliniar.

NO. 1139, VOL. 44]

As path is to cortex, so as cell-pressure to cell-membrane. But Hofmeister would not have accepted any such comparison. In the case of accliular organs he localized both the erectile and passively extended by the active growth of the inner layers of the cell-wall.

It is remarkable that the obvious source of power which th pressure of the cell-sap against the cell-walls supplies should have been so much neglected This may perhaps be accounted for as a revulsion against the excessive prominence given to

osis in the works of Dutrocher

omnous in the works of Districtlet. The great fail of Hofmeister's views was the purely mechanical minner in which he believed changes in extensibility in the passers immess to be brought about. When an apages—on the property of the prope obvious cases of response to stimulation as the movements of Mimona. In this respect it was a retrogression from the varw of some earlier writers, Distrocher's clear statement (1824) as well be quoted lower down. Territorian, as his "Flynologies" (1838), speaks of gestropism as a Triet, or impalies, and adds that though there is no question of desire or resension, as in the impulses of animals, yet geotropism must be thought of as some large higher than a merely mechanical or chemical action.

thing higher than a merely mechanical or chemical action. In taking used a view Holmester naturally neglected the basis and the state of the state o what are now universally considered parts of a single pheno-menon—vis negative and positive geotropium. He gave the pending up a riem. It is well known that he supposed a root to be plastic, and to bend over by its own weight, like a tallow condide on a hot day or a piece of heated scaling wax. The development of a unified view of feliotropium, geotropium,

and other similar curvatures is a part of my subject, and for that reason the curions want of unity in Holmeister's views is in-

teresting.
In 1865, Sachs published his "Experimental-Physiologie"
He here accepts Hofmeister's views with certain modifications.

Irritability,

When by a touch on a tugger the explosion of a putol is caused, we do not say that the putol is irriable, but when in an ongassan a tunilar release of source) persenge occur, we apple the term irriability to the phenomenon, and we call the influency which produced the change a stimulus. At the time (1865) there was as far as I can discover, no literal that growth—time (1865) there was a far as I can discover, no literal that growth—time (1865) there was a far as I can discover, no literal that growth—time (1865) there was a far as I can discover, no literal that growth—time (1865) there was a far as I can discover, no literal that growth—time (1865) there was a far as I can discover, no literal that the control that the growth of the control that the growth of the control that the growth of the control that the

1 "Recherches anat. sur la Structure Intima, &c." (1844), p 107. Dutro-chet, however, was not consistent in this matter, and later on gave explana-tions as mechanical as Hofmeister."

botanical mind should have taken more than fifty years to assimilate Dutrochet's new.

In 1868 Albert Bernhard Frank published his valuable in 1869 Albert Bernhard Frank published his valuable for the published has been supported by the published has been supported in more than one went published his published has been supported in more than one went published his published his office and the man fart suggested in initiation of the existing expression "heliotrophim." This uniformity of nomenclature had an advantage beyond mere convenience, for it served to emphasize the were that the curvatures were allied in character. His crit-tion of 1 160 neutre and Sacha were directed against the follow-

clams for requirements and other positively georopie organs (i) That roots and other positively georopie organs band owing to plasticity. By repeating and varying certain older experiments, Frank helped materially to establish the now older experiments. Frank helped materially to establish the now universally accepted wew that pouting egotropless as an extre-not a passive, curvature, and that it depends, like apogeotropism, on on unequal distribution of longitudinal growth Here, again, he introduced unity, bringing what had been considered different phenomens under a common heading. By studying the distribution of growth and of tension in a variety of curvatures he

helped still more to unite them under a common point of view.

(ii) He showed that Hofmeister's classification of organs into those (1) which have and (2) which have not tension, was valueless in connection with growth-curvatures; that is to say, that apogeoropsium is not necessarily connected with the form of longitudinal tension found in growing shoots, and that the distinct kind of tension existing in roots has no connection with their positive geotropism. His work thus served to hring the their positive geotropism. His work thus served to bring the subject into a more purely physiological condition, not only by subject mot a more purely pnysiological condution, not only or his downight opposition to a mechanical theory backed by the great name of Hofmeister, but also by giving importance to physiological individuality In 1879, Frank published a more important work, "Die natur-tiele wagerechte Richtung der Pfianzenthellen." This paper

In 1870. Frank published a more important work, "Due naturaliche wagerechte Richtung der Pfinanzentellen." This paper not only tended to muit geotroplim and heliotropasm by proving the phenomena described to be common to both acagories, but der help the properties of the phenomena described to be common to both acagories, but horizontal growth must be the field of with by showing that horizontal growth must be the field of with by showing that horizontal growth must be used to be a secondary of the resetton of plants to light and gravatation which has been most fruitful Famils showed that certain parts of plants, for entance the horizontal growth and the state of the control of plants to light and gravatation which has been most fruitful Famils showed that certain parts of plants for entance the horizontal parts of the pattern on negative, but transcere. Ten years later transcered to it. Here, and Frank is a new uppe of geotropain, number positive and negative, but transcere. Ten years later than the pattern of the plants of the pattern of the plants of the pattern of the plants of the plant on the individual and highly sensitive constitution of the plant in question. It is, of course, true that those who need for mechanical explanations of growth cursuaters might be able to mechanical explanations of growth cursuaters might be able to did such a not for transverse geotropian. But when Frank's acceptable; and, judging from my own experts lead and could that Frank's work descreted to have a powerful effect in pre-paring the minds of physiologuats for a just view of irritability. The builder in transverse geotropian received interesting supporting the minds of physiologuats for a just view of irritability. The builder in transverse geotropian received interesting supporting to the state of the property of the minds of physiologuats for a just view of irritability. The builder in transverse geotropian received interesting supporting to the property of the

undoubtedly right, his views were strongly opposed at the time. He held similar views on the effect of light, believing that the power possessed by leaves of placing themselves at right angles to the direction of incident light must be considered as a new to the direction of incident light must be considered as a new type of helitorype movement; nanwers or diabeliotropism. Frank's views were criticated and opposed by De Vires (Sachis the Witzburg Laboristor), titted to above that Frank's results can be explained without having resort to new types of geo-orholtorpism. De Vires believed, for mistance, that a led' may be apheliotropisc and apogeotropic, and that its horizontal posi-tion under vernell illumination in othe to a balance struck between the opposing tendencies, one of which calls forth an unward, the other a downward curvature

oner a downward curvature.

The same point of view occurs again in Sachs's paper on "Orthotrope and Plagotrope Plant members" (Sachs's Arbeiten, 1879). Sachs holds to the opinion that Frank's theory is untenable, that it is upset by De Vires, and that the oblique on horizontal position is to be explained as the result of a balance

between opposing tendencies
In a paper published the following year, 1880 (Journal Linn
Soc.), I attempted to decide between the opposing views. My Soc.), I attempted to decide between the opposing views. My experiments proved that at least certain leaves can place themselves at right angles to the direction of incident light when there is no possibility of a balance being struck. The outcome of my experiments was to convince me that Frank's views are correct—namely, that the quality of growth called transverse heliotropism does exist.

This view was accepted by my father in the "Power of Move ent." The conclusions of Vochting, in the Bot Zeitung, 1888, and Krabbe in Pringsheim's Juhrbucker, 1889, vol. xx, are on

and Kiabbe in Fringsheim's Tyleheinder, 1880, vol. 2x. ax on the same side of the question the same side of the question of the part of th posts, not as direct causes.

Frank saw clearly that plants may gain such various aptitudes for reacting to light and gravitation as best suit their modes of

In stating this view, he refers to the influence of the "Origin of Species," which had shown how any qualities useful to living things might be developed by natural selection. Fraink described the qualities thus gained under the term fodarity. He supposed that the cell-membranes of a transversely believotopic lest (for instance) were so endowed that a ray of light striking it obinstance, were so encover that a ray or ugit striking it ob-iquely from base to aper produced an increase of growth on the product of the product of the product of the base caused a reverse movement. The polarity-assumption of Frank is a purely gratutions one, and, if strictly interpreted, hardly tends to bring growth-curvatures into harmony with what we know of the relation of life to environment.

It will no doubt appear to be a forcing of evidence if, after such a statement as the last. I still claim for Frank that he led such a statement as the last, I still claim for Frank that he led the way to turn modern were of traibality. I can, of course, only judge of the effect of his writings on myself, and I feel sure that they prepared me to accept the modern view I must also be institled that Frank, in spite of his assumption of polarly, also be institled that Frank, in spite of his assumption of polarly, and different from our of the present odly. Thus, he compares the action of gravitation on plants to the influence of the perception of food on a chicken. He peaks, no, of custom Qurantal Linn. Soc., 1850, p. 94), or use, building up the specialised "matinet" for certain Curvairus. These are expressions consistent with perfectly just in speaking of Frank's belief to different fixeds of principlings, they have followed:

perfectly just in speaking of Frank's belief in different kines or irribablys, although is so judging be may prhaps have followed equity rather than law. One of the whole the perfect of the perfect flamence, and markedly indisenced, by differences in illumina-tion. Please grow more quickly, desires persists, it adukness than in light-. With this fact to go on, it was perfectly natural that sumple mechanical explanations of heliotopolam should be made. De Candolie, as it well known, explained such curves by the none apple growth of the shaded side. Thus it

came about that heliotropism was discassed, for instance, in Sach's "Text-book," cell. 4, 1874, under the same heading as the influence of light on re-tilinear growth. Shorily afterwards, in 1876, a pupil of Sach's—Muller-Thangas—published ("Forn") a research carried out in the Wurtburg Laboratory, which is of some Importance. In the introductory remarks he work — ""It has been hithirts supposed that helications." remarks he wrote — "It has been hills rio supposed usa neutropic curvatures depend on a difference in intensity of illumination on the two side— Sachs came to a different or apinon in his work on geotropism he found himself compelled to believe that in heliotropic, just as in geotropic curvatures, it is not a question of different intensities on opposite sides, but rather that heliotropic effect depends on the direction of the light,"

Muller's research gave weight to this union of geo- and helio-tropic effects by showing a number of resemblances in the tropic effects of showing a number of resemblances in the manner and form of the two curvatures. Again, when it was found that apheliotropic organs are influenced by light and darkness in precisely the same manner as positively heliotropic ones, it became clear that the mechanical explanation of De Candolle was untenable for negatively heliotropic organs, it might still no doubt be upheld for positively heliotropic organs, but, as a matter of fact, it was not so upheld. There was a tendency to unify our view of growth-curvatures, and the union of the two forms of heliotropism gave strength to the movement. Nor was this all , when it became clear that light did not produce heliotropic curvatures by direct mechanical effect, it was natural neitotropic curvatures by direct mechanical enect, it was natural to remember that gravitation has none either, we cannot point to any reason (except the crudest ones) why the lower side of a horizontal root, should grow the faster for the direct effects of gravitation. That being o, light and gravitation ould be classed together as external so, light and gravitation could be classed together as external agencies acting, not directly, but in some unknown indirect manner. I do not imply that such a result followed immediately, but that the line of research above alluded to helped in some degree to lead the way to a belief in growth-curvatures as phenomena of irritability

when my father was writing our book, "The Power of Movement in Plants" (1880), in which he adopted to the fullest extent a belief that growth-curvatures are phenomena of irritability, the only modern statement of such a view which he only, the only modern statement of seem a view within the could find was in a passage by Sach (Arbeiten, i., 1879, p. 282), where he writes that "The living material of plants internally differentiated in such a way that different parts are supplied with specific energies resembling those of the sensory energe (Simietnaryen) of animals. Anisotropy in plants fulfils

the same purpose as do sense perceptions in animals."

The idea of irritability as applied to growth-curvatures is expressed with sufficient clearness in "The Power of Movement." expressed with sametent clearness in "the Fower or move ment." Thus, for the case of goodrop in we wrote [6, 521].—"Different parts or organs on the same plant, and the same part in different species, are this excited to act in a widely different manner. We can see no reason why the attraction of gravity should interedly modify the state of turgetience and ashequent growth of one part, on the tupper side, and of another controlled to the state of turgetience and so the state of turgetience and so the sequent growth of one part, on the tupper side, and of another controlled to the state of turgetience and turgetience and the state of turgetience and geotropic, apogeotropic, and diageotropic movements, the purpose of which we can generally understand, have been acquired for the advantage of the plant by the modification of the ever-present movement of circumnutation. This, however, implies final gravitation produces some effect on the young tissues sufficient to serve as a guide to the plant." A similar view is given for heliotropism. It should be noted that the essence of the view—namely, that light and gravitation act as guides or land-narks by which the plant can direct itself—can be held without a belief in circumnutation.

a belief in circumsutation.

In Feffer's admirable "Planzenphysiologie," 1881, the conception of stimulus and reaction is fully given, and is applied, among other cuest, to that of heliotropism and geotropism Pfeffer states clearly, and without reserve or obscurity, the view that light and grantition cat as attend or releasing forces, in manners decided by the organization of the plant. Pfeffer seems to me to be the first without who has trated the subject.

fully and consistently, In Sachs's "Vorlesungen" (1882), a view similar to that briefly sketched in his paper of 1879 is upheld Geotropism In his "Vorlesungen," p 854, Suchs states that he wrote Müller-

In his "Vorteungen," p. 946, oncore source that the work of Thurgau's involution of Schmitz, Limnaca, 1641; Müller-Thurgau ("Flore," 1876), F. Dorwin, Sachu's Agekrin, 1860. The two latter researches were carried out under the direction of Sachaan his laboratory.

and heliotroptism are described as Resercehasunges, i.e., phenomens of stimulation. The phenomena in question are described under the heading Antiotrops, a word which expresses, exceeding 0 Statis p. 550. The same external forces assure the most varied directions of growth. In another passage (p. 859) he states that the anisotropy of the different organ "in the most varied directions of growth." In another passage (p. 859) he states that the anisotropy of the different organ "in the state of th

physiology.

I cannot, however, omit to mention Pfeffer's (Tubing.n., Untersuchungen, vol. 1) brilliant researches on the chemotaxis Uniterinctuangen, vol. 1) brilliant release on the chemicasis (untability to certain resignits) of low organisms, such as antherozoids and bacteria. To take a single instance, Pfeffer showed that ithe antherozoids, in responding to the effect of make add, follow precisely the same law that in animals corre-tates the attempt of stimulus and amount of effect. Tha result, although it has no direct connection with growth-curvatures, is nevertheless of the highest importance in connection with the

general question of vegetable irritability. general question of vegetable irritations.

Nor can I omit to menuon the ingenious reasoning by which
Noll (Sachs's Arbaten, vol up, 466) localized the seat of irritability in a vegetable cell. He points out how in acellular
plants, such as Caulerpa or Derbesta, the flowing protoplasm may travel from positively geotropic root to apogeotropic stem, may travel from positively georying tool to apageotropic amounts and he argues from this that the motile endopiasm cannot be the eat of specific irritability. The flowing plasma, which is always changing its position with regard to external forces, must be as fully incapacitated from responding to them as though the plant were turning on a kinosiat. It follows from this that it must be the stationary ectoplasm which perceives external change From a different point of view, this is what we should expeci—we should naturally suppose that the part which regu-lates the growth of the membrane, and therefore the curvature of the cell, should be the irritable constituent of the cell

contents of the stabilithment of a stabilithment of

The first step in advance of Holmeister's views was the esta blishment that the curvatures under consideration are due to unequal growth—that is to say, to an excess of longitudinal unequal growth—that is to say, to an excess or longitudinal growth on the concave side. It is not, however, easy to say how far. Hofmester had this idea, for it, in fact, depends on how we define "growth." Hofmester keep, of course, that the convex side of a curved shoot was longer than it had been before the curvature occurred, this is a the concave side increases in length during the curvature occurred. three These permanent elongations he must have known to be growth, but his attention was directed to what it, after all, the more important point-namely, why it was that unequal clonga-

more important point—namely, robylt was that unequal enouga-tion took place.

Sachs, in his "Experimental Physiologie," held that growth-curvatures reducto unequal growth. In his "Text-book" (1874), English translation, 185a, p. 553, the author, referring to Hof-metics" work, say, —"I pointed out that the growth of the mental work of the properties of the properties of the properties of the accelerated, and that of his properties of the accelerated, and that of the upper surface retarded; I did not at the time express an opinion as to whether these modifications of growth were due to an altered dustribution of plantic material of the control of the control of plantic material. The control of the control of plantic material control of the control of the

sharp curve close to the tlp of a geotropic root, and the long searp curve close to the tip of a geotropic root, and the rong gradual curve of an appoetropic shoot, are necessary conse-quences from the manner in which growth and distributed in these parts. He demonstrated that rectlinear growth and geotropic curvature require the same external conditions; that, for instance, a temperature low enough to check growth also puts a

stop to geotropism.

The distribution of longitudinal growth, which produces g Internation of longitudinal growth, which produces geo-tropism, was afterwards studied by Sachs (Arbeiten, 1 p 193, Jane 1871), who thoroughly established the fact that the convex side grows faster, while the concave side grows slower, than if the organ had remsined vertical and uncurved.

the organ had remined vertical and uncurred.

These facts are of interest in themselves, but they do not, any more than Frank's results, touch the root of the matter of the produced by the produced by growth.

The next advance in our knowledge did, in fact, accompany advances a root knowledge did, in fact, accompany advances are not knowledge did in the submitted of produced to the control of provided the produced of the produced by the hydrostatic pressure examing within In a force was at had by which growth could be concerved to be osmosis, which gives the force by which the cells are stretched, as force was at hand by which growth could be conceived to be caused. The first clear definition of turgor, and a statement of its importance for growth, occurs in Sach's classical paper on growth (Arbaten, p. 104, August 1871)

As soon as the importance of turgor in relation to growth was clearly put forward, it was natural that its equal importance with regard to growth curvatures should come to the fore, and with regard to growth on trivatures should come to the fore, and that increased growth on the convex side (leading to curvature) should be put down to increased internal cell-pressure in those trivates. In the fourth edition of Sach's "Lehrbach" (1874), Eng trana, 1882, p 334, such a view is tentatively given, but the author saw very clearly that much more evidence was needed author saw very clearly that much more evidence was needed before anything like a conclusion as to the mechanism of move-ment could be arrived at. The difficulty which faced him was not a new one—in a slightly different form it had occurred to Hofmeister—the question, namely, whether the curvatures of acellular an I multicellular organs depend on the same or on different causes. If one explanation is applicable to both, then omerent causes. It one expinantion is applicable to both, then we must give up as a primary cause any changes in the osmotic force of the cells. For no change in the pressure inside a cell will produce a curvature in that cell, whereas, in a multicellular organ, if in the cells in one longitudinal half an increase of cosmotic substances takes place, so that the cell-walls are subject

to greater stretching force, curvature will take place.
On the other hand, if the cause of bending of acellular and multicellular organs is the same, we must believe that the curva-ture takes its origin in changes in the cell-walls. In an accludature takes its origin in changes in the centwants. In an accounts organ, if the cell-membranes yield symmetrically to internal pre-sure, growth will be in a straight line; if it yields asymmetrically it will curve Thus, if the membrane along one side of a cell becomes more or less rest-ting than the rest of the membrane, a curvature will result

memorane, a curvature wair reasu; If we are to apply strictly the same principle to accillular and multicellular organs, we must suppose that the whole organ curves, because each individual cell behaves the one of the above-described free cells, the curvature of the whole resulting from the sum of the curves of the separate cells. This was Frank's view, and it also occur in Sach's "Tear-book" (1879.)

Eng trans., 1882, p. 842. re we bound to believe that the mechanism of acellular and Are we bound to believe that the mechanism of acellular and multicellular curvatures is so strictly dentical as Frank supposed? In the first place, it is not clear why there should be thenlity of mechanism in the movements of organs or plants of completely different types of structure. The upholders of the

completely different types of structure. The combination of the completely different types of structure. The combination caphanido must apply to both cases. I believe that light may be thrown on the matter by condicing turquescee, not may be thrown on the matter by condicing turquescee, not may be through the complete that the combination of the properties of the combination of the properties of the combination of the properties of the combination of the combinatio

by the cell wall in one case is carried out by cortical tissues in the other If this is the case for one function, there is no reason why is should not hold good in another, viz the machinery of movement.

If we hold this view that the cortex in one case is analogous with a simple membrane in the other, we shall not translate the unity of accilular and multiccilular organs so strictly as did Frank Indeed, we may fairly consider it harmonious with our knowledge in other departments to find similar functions per-formed by morphologically different parts. The cortex of a geotropic shoot would thus be analogous with the membrane of a geotropic cell in regard to movement, just as we know that these parts are anniogous in regard to stability.

In spite of the difficulties sketched above, one writer of the

first rank, namely, H de Vries, has upheld the view that growth curvatures in multicellular organs (Bet Lutung, 1879, p. 835), curvatures in multicellular organs (Irel Zeitung, 1879, p. 858), are that to increased cell-prevaue on the convex safe, the rease of annote sub-stances in the cell-cap of per down increase of cannote sub-stances in the cell-cap of per down increase of cannote sub-stances in the cell-cap of per down increases of cannote sub-flowed naturally from De Vries's interesting plasmolytic work (label 1877, p. 1). He had shown that those sections of a targe-cent short which were in most rapid growth show the targe-cent shoot which were in most rapid grown show use greatest amount of shortening when targescence is removed by plas-molysts. This was supposed to show that growth is proportional to the stretching or elongation of the cell-walls by turgor. Growth, according to this view, consists of two processes (1) of a tem porray elongation due to turgescence, and (2) of a high procesby which the elongation is residered permanent. De Vies assumed that where the elongation occurred, its amount must be proportional to the osmotic activity of the cell contents, thus neglecting the other factor in the problem-namely, the variability in the resistance of the membranes. He applied the He applied the ability in the resistance of the membranes. He applied the plasmolytic method to growth-curvatures, and made the same deductions. He found that a curved organ shows a flatter curve farte being plasmolytes and This, according to his previous argument, shows that the cell-sap on the convex is more powerfully connote; than that on the concave side. This again leads to

fully ownotic than that on the concave since I mis again remore to increased cloth-stretching, and finally to increased growth. The most serious objection to De Vries's views is that the convex half of a curving organ does not contain a greater amount of osmotically active suistance. It must, however, he noted in of osmotically active suissance. It must, nowever, we now in the heliotropic and gootropic curvature of pulyini, there is an osmotic difference between the two halves 4-so that, if the argument from uniformity is used against De Vries (in the matter of accellular and multicellular organs), it may fairly be used in his favour as regards the comparison of curvatures produced with and without pulvini

It is not easy to determine the extent to which De Vries's views It is not etsy to electrimise the extent to which he is in extent to on the mechanics of growth curvature were accepted. The point, however, is of no great importance, for the current of conviction soon began to run in an opposite direction. "acks ("Lehrbuch," ed 4, Eng trans p 835) had already pointed out that attentions abould be directed to change in

extensibility of cell-walls as an important factor in the problem Wiesner, in his "Heliotropische Erscheinungen" (I unit Misser), vol. lxxxi, 1880, p. 7, also in the Denkschriften, 1882), held that the curvature of multicellular organs is due both to an increase of osmotic force on the convex side, and to in-creased ductility of the membranes of the same part. He creased ductility* of the membranes of the same part. He repeated De Vrne's plasmolynic experiments, and mode out the currons fact that in many cases the curvature is increased instead of being dimmashed. He attributed the result to the concave tissues, being more perfectly elastic than ductile convex tissues, so that when turgescence is removed, the more clastic tissues.

shorten most, and, by diminishing the length of the concave side, increase the curvature.

Strasburger, in his "Zellhaute" (1882), suggested that growthcurvatures are due to increased ductility of the convex membranes, and gave a number of instances to prove that a change to a ductile condition does occur in other physiological processe such as the stretching of the cellulose ring in (1, togonium to a

Frank made similar experiments, but failed to find any diminution of

412

uniform thin membrane, the branching of Cladophora, and the excape of sexual products in certain Alge.

We now pass on to the work of two observers, Wortmann and Noll, who have devoted special attention to mechanism of curvature of acciliust and multicellular organs must have a saumption, altered several times mentioned, that the growth-curvature of acciliust and multicellular organs must have a common cause. He began by tending Kohl's statement (Ret. Hight, Marburg, Field's (I have not seen Kohl's paper) that when the concave wail. Wortmann principally investigated the curvature decovered in Phytomyces by Erres (Ret. Zeitzurg, 1884) which can be profined by contact. When the hypha is toched with a plant filtered or worth a plantum wire, or by allowing a speck side. The hypha is so highly sensitive to contact that it curves in from three to sum mininte; it is clearly a growth-curvature, a toched visited. sion. In the pyper as so nighty sensitive to contact that it curves in from three to sat minners; in a clearly a growth-curvature, curvatures thus produced, as well as in apogentropic and helicotropic curvatures, the accumulation of protopiatum on the concave side is, according to Wortmann, clearly visible, and, what is more important, the membrane becomes thicker on the want is more important, the membrane becomes thicker on the concave side, sometimes twice as thick as on the opposite side of the cell. In consequence of the unequal thickening of the membranes, the cell is supposed to yield asymmetrically cell-pressure, and the necessary consequence is that the cell grows into a curved form.

In applying the same method of investigation to multicellular arts, Wortmann followed Ciestelski (Cohu's "Beltrage," 1872, parts, Wortmann followed Ciesielaki (Cohu's "Beltrage," 1872, p. 1; who noticed that in geotropically curved roots the cells of the concave (lower) side of the organ are much more densely filled with protoplasm than are the convex cells. Sachi ("Vorlesmigen," p. 842) describes a similar state of things in the halms of grasses, and Kohl, agam, in tendrals and the stems of climbing plants.

Wortmann first of all made sure that no redistribution of prote Worfmann first of all made sure that no requirement on proto-plant mould be observed in the individual cells of curving multi-cellinar organs. If each cell behaved independently like a free cell, we might expect to find a collection of protoplasm on the concave wall of all the constituent cells of a curving shoot. But this is not the case. Nor at first could any microscopie differences be made out between the concave and convex tiss of a curving shoot. But when the stimulus was made to act for of a curving about. But when the stimulus was made to act for a long time, differences were apparent. A young Thaseolus are also as the property of the property of the story the tissues was visible The cells of the cortex on the upper side became densely filled with protoplasm, while the lower cor-tical cells were relatively poor in protoplasmic contents. The same changes in the membranes occur as those noticed in Phy-comyoss—that is to say, the walls of the cortex on the upper side are very much thicker than those on the lower side.¹

Since the walls of the cortical cells have become more resisting on the upper than on the lower side, then (assuming the osmotic expanding force to be the same in both cases) the growth will be quicker on the lower side, and the shoot will curve upwards. Wortmann states that his observations account for the fact that the convex side grows quicker, not merely than the concave, but than a normal nubent shoot. But he does not seem to have compared the thickness of the convex cell walls with the normal, although he states that they are poorer in protoplasm than is usual, and from this it may, according to his views, be perhaps med that the membrages are abnormally thin,

Wortmann points out that his views account for two well known features in growth-curvatures, viz. the latest period and the after effect. If a curvature can only occur when a difference in structure of cell-walls has arisen, it is certainly natural that some time should occur before the curvature is apparent. I do not lay much stress on this part of the subject, as I feel sure the whole question of latent period needs further investigation With regard to after-effect it is true that Wortmann's views account for the continuance of curvature after the stimulus has ceased to act.

Wortmann attaches great importance to another point in his Both protoplasmic change and thickening of cell-walls occur to some ex-

theory, which, could it be established, would be of the greatest interest, and would unlie under a common point of view, not only acciliate and multicellate organs, but also nated protoplasm, e.g. the plasmodus of myxomytetes. The wew in other constructions are constructed by the construction was testinizely suggested by Seath, "Lichtonic," 1874; physiologie," ii p. 331) he a similar sprint. The apogeotropic curvature of a Physomogree-hybal is supposed to be due to the unequal theckening of the membrane on the upper and ol lower than the construction of a physomogree-hybal is supposed to be due to the unequal theckening of the membrane on the upper and ol lower than the lower to the upper and of the Coll. In the same way in a multicellular organ the protoplasm is supposed to migrate from the lower to the upper and of the Coll. In the same way in a multicellular organ the protoplasm he spope cortex and pith to the upper cortex and pith to the apogeotropian of a cell or a multicellular part would be due to the spogeotropian or tendency to migrate vertically upward of the protoplasm. There are great difficulties in the way of a curved Physomogres-hybal, unwhich protoplasm has accumulate an extra constitution of the protoplasm. There are great difficulties in the way of a curved Physomogres-hybal, unwhich that is Nitelia and in Bryonathe carculating protoplasm continues in movement, and done accumulate in any part of the cell. Lastly, there seems and in Bryonathe carculating protoplasm continues in movement, and done expected. Morrover, he points of that is Nitelia and in Bryonathe carculating protoplasm continues in movement, and done expected. Morrover, he points of that is Nitelia and in Bryonathe carculating protoplasm continues in movement, and done accumulate in any part of the cell. Lastly, there seems and part of the cell. Wertimen's local protoplasm continues of the cell work of the part theory, which, could it be established, would be of the greatest

changes are the result aut not the cause of the curvature. Living also produced curvature in Phaseois by bending the aparting also produced curvature in Phaseois by bending the apartines of the produced by is a result, do of curvature, but of strain mechanically produced When a plant is prevented from executing an apogeotropic movement it is clear that a longitudinal strain is put on the upper (concave) side. But the longitudinal strain in Elfving's plants so on the convex side. Therefore, if, as Elfving believes, the visible changes are due to strain, they should, as they do, occur on the convex side in his experiments, on the concave in

Wormann's replied in the Bot. Zatung, 1888, p. 469, and at-tempted to explain how Elfving's results might be explained and yet his own theory hold good. The reply is by no means so strong as the criticism, and it must be allowed that Elfving has

strong as the criticism, and it must be allowed that Elfving has estimated with workensam's argument and the No. 18 control of the N

Noli further points out what is undoubtedly a fault in worn-manu's theory—namely, that he explains the retardation on the concave rather than acceleration on the convex side. This crit-cism is only partially just, for though Wortmann's description only shows a relative thinness of the walls on the convex side, yet it is clear he believed there to be an absolute diminition of

yet it a clear he believed there to be an absolute diminution of resisting power on that side. No'll's experiments with grass halms show clearly that accelera-tion of growth on the convex and is the primary change, rather than retartation along the concave half. When the halms are fixed in horizontal glass tables, so that they are situatised but unable to bend, the lower half of the pulvinus forms an irregular ourgrowth, increasing radially since it is not able to linewas longitudinally.

A similar argument may be drawn from Elfring's experiments. He found that the pulvini of grass halms placed on the kinnostat increase in length. This experiment shows incidentally that the kilnostat does not remove but merely distribute equally the geokilhoutst does not remove but merely distribute equally the goo-tropic similars; as thos that geotropic strimbute leads to increased, not to diminished growth. The same thing is proved by the simple fact that a grass halm shows no growth in its pulvinas while it is vertical, so that when curvature begins (on its being placed horigonist); it must be due to acceleration on the convex, since there is no growth on the concave side in which retardation could occur. Notify wive a that the primary change as an increase in extensibility of the tissues on the convex side. view he proceeded to test experimentally. A growing shoot was fixed in a vertical position, and a certain bending force was applied to make it curve out of the vertical, first to the right and then to the left. If the cortical tissues are, at the beginning of the experiment, equally resisting all round, it is clear that the excursions from the vertical to the right and left will be equal excursions from the vertical to fie right and left will be equal As a matter of fixet the occasions to the right and left were the state of the control of the right and left were to the subsequent result. The shoot was then placed horna-tally until getorijo or other curvature was just beginning, when the above bending experiment was repeated. It was then found the shown bending experiment was repeated. It was then found the excursion was greater than it had been In the five experi-ments given by Noll the excursion in the opposite direction stretching of the concave side was less than it had been, and (stretching of the concave side) was less than it had been, and the state that all the other experiments showed a similar result. The increased extensibility of the convex side as clearly the most striking part of the phenomenon, but I fail to see why Noll Takes as the property of the and the curvature were due to discrence in osmoit force on the convex and concave sides, the shoot would react differently in the two directions; for Instance, the concave side would be more easily compressed. Noil and Wormsan's explanations differ in this: the former lays the greater stress on the increased extensibility of the convex side, the latter on the dimination of that of the concave side. Again, Wortmann explains the dif-ference in extensibility as due to differences in thickness of the cell-walls. Noll gives no mechanical explanation, but assumes that the ectoplasm has the power of producing changes in the quality of the cell-wall in some unknown way.

quality of the cell-wall in some unknown way.

In the early sages of curvature, a phenomenon takes place to
which Noll attaches great importance as supporting his view.
When a curved organ is plasmolyzed, it suffers a dimmution of
curvature, as De Vries showed, but Noll i has proved that in the curvatine, as De vice showed, but not in any phorea use in use early stage of curvature a contrary movement occurs—that is to say, the curvature is increased. This seems to show that the yielding of the convex sets so wing to a dettility, which prevents its holding its own against the more perfect elasticity of the conteave sets of but this is only the beginning of the phenomenon; as the plasmolyzing agent continues to act, a reverse movement takes place, the well-known flattening of the curva-ture described by De Vries. It is to me incomprehensible how in a given condition of cell-walls these results can occur in dif-ferent stages of plasmolysis. I can understand one occurring when the curvature is recent, and the other, the flattening of the curve, occurring when the ductile convex parts have reacquired elasticity. The fact undoubtedly is as Noll describes it his

explanation seems to me inadequate

We have now seen that the most acceptable theory of the
machinery of these curvatures is in its main features akin to Hofmeister's, the power of elongation supplying the motive force, while the varying extensibility of the membranes determines the nature and direction of the bend.

nature and decition of the bend.
The question now arises: It it possible by these means to
The question now arises the state of the control of the
theory for which there is most to be said on experimental
grounds—vis. No!!—it will be noted that it is essentially connected with the decrine of growth by apposition. The question,
neeted with the decrine of growth by apposition. The question,
for the phenomens of ordinary growth, may be applied suitedir
metandar to growth curvature. This doctrine in ats original
purity absolutely requires turgescence to account for the clongspurity absolutely requires turgescence to account for the clongs-* The similar results obtained by Wlasner are noticed above

NO. 1130. VOL. 44]

tion of growth. The older layers, separated from the ectoplasm by the younger layers of cell-wall, can only be elongated by traction. Growth by intussusception does not absolutely retraction. Growth by intussusception does not absolutely require this force; the theory that the micellee are separated by traction, and thus allow intercalation of fresh micellee, is a view for which Sachs is chiefly responsible

for which seems is enterly responsible. Since surface growth by apposition is absolutely dependent on the traction exercised by cell-pressure, it is a fair question—how fair growth is influenced by foreithe clongstion. Baranetshy ($Alim \ Acad. St \ Ptt., v. vol \ xxviv p. 20)$ states that when a plant is subject to traction, as by even a small weight attached to the free end, the rate of growth is lowered. Almoran (Pringsheim 2, Aurher), axis, less a Limmentann points out in the same connection, found no increased elongation of collenchyma when stretched for some days by means of a weight A greater difficulty is that growth may be absolutely and at once stopped difficulty is that growth may be absolutely and at once stopped to by placing the growing organ in an atmosphere free from oxygen apparently does not dimunch targeteene, yet growth atons, the collection as uncreasing in length by mechanical stretch-ing, and if the turger is not interfered with, increase in length ought to continue. The same thing applies to curvatures upon the continue of the co concave, turgescence, as far as we know, continues, yet no after-effect is observed. The same result may be gathered from concave, turgescence, as her as we know, continues, yet no affect concave, turgescence, as her as we know, continues, yet no affect Adheasays's lineteresting experiments on the growth of roots, He showed that lowering the temperature has an almost instances lathburst effect on growth. Thus maste roots (at a micrometer per hour, were placed in water at \$\cdot\), and absolutely no growth occurred during the following ten minutes, in which the thermometer rose to 6'c; Thiresual is all the nove-valuable to the state of the plant of the plant of the state of the actual to the plantopict chortening, is about the same whether the root is in full growth or not growing at all. This is a estimated by plantopicts chortening, is about the same whether the root in full growth or not growing at all. This is a conclusive, for it the growing cell-walls were facultie they the non-growing cells might shorten a good deal, owing to their more perfect cleanting; \(^1\) therefore Aukensay's plasmolytic results are not in this particular connection of great importance, creatly are not in this particular connection of great importance, creatly are not in the particular connection of great importance, creatly are not in the particular connection of great importance, creatly is

except as showing that the non-growing roots were certainly to some extent turgeteent. There are other facts which make it extremely difficult to understand how surface-growing can depend on cell-pressure Nageh ("Starkehorner," p 379) pointed out that the growth of syndiciated rely such colorage commonly to those being out-significations of the surface and the surface of the surface of the surface of the surface and the surface of the s An intermodal feel of Nitella increases to 2000 times its original heigh, while it only becomes ten times as wide as it was at fact. The name of the control of the control

tion remains a problem for those who occure in some growing by apposition.

The point of special interest is that differences in extensibility and different differed one cannot be supposed to exist in a homogeneous membrane. If any purely physical characters can be applied to the control of the control of

^{*}Dentek Bet. Grs., 1800, p. 61. The paper contains an excellent discussion on the mechanics of growth, to which I am much indebted "Life, et P. 1878, Act P. 1878, T. 288, vol. 1872; T.

Such structural differences do, of course, exist, but whether they are unficient to account for the phenomena is different question. Straburger ("Zellhaute," p. 164) supposes that the elatibity of a cell-wall depends on the lest-formed layers, and as in these the microsomes are seen arranging themselves in lines or patterns, we have a heterogeneity of structure which may or may not be sufficient.

414

not be summent. We have now seen that it is difficult to believe, although it is not inconceivable, that the extending force of cell-urgor, combined with differences in extensibility of the membranes (depending on structural characters), may account for the phenomena of rectulinear growth. But, even if we allow that this is so, how are we to apply the same explanation to growthcurvatures? How are we to account for the rapid changes in extensibility necessary to produce geotropic or heliotropic curva-tures? The influences which Strasburger and Noll suppose 10 act on the cell-walls and render them ductile cannot account for act on the ceri-walls and render them duettle cannot account for settensibility non-direction only. Nor does Wortmann's theory, that difference in extensibility depends on difference in thek-ness, meet the case completely. What we used is an increase in longuidual, not in general extensibility. I presume that theogenization might say that the excess in longuidual extensibility is always present whether geoeral extensibility is greater or less. In the meanwhile we must pass on to more recent

or less In the meanwhile we must pass on to more recent researches on surface-growth by apposition. In Strasburger's later work ("Histologusche Bedrage," 1889), his views on growth have undergone c-naiderable modification. The study of certain epidermic cells, of the folds in membranes, and the repetition of Krabbe's work on certain bast fibres, have and the repetition of Krabbe's work on certain bast fibres, have convinced burn that appointion does not account for all forms of goowth. Krabbe (Fringithem's Jake's, xmr) showed that in without any sixth amount of thinning in the membrance as would occur if the bulging were due to stretching. The only possible explanation seems to be that there is a migration of new material into the cell-wall. Such intustiception might be, as Neget supposed, a flow of fland out of which new miteellie crystallize; but it is now established that cellulose arises as a crystalisate; but it is now established that cellulose anset as a modification of protoplasm, so that it would harmonize with our Poowledge of the origin of cellulose if we assume that intussacterion was preceded by a wandering of protoplasm into the cell-wall. Such a state of things would render possible the regulation of longitudinal growth in the case of Nitella and Spirogras, already alluded to, as well as in growth curvatures. This view might also harmonize with Weisner's theory (Sixt.)

This view might also harmonize with Wiesner's theory (size, Wien Adad, 1885, vol. xon; p 17) that the cell-wall contains protoplasm as long as it continues to grow. For the sake of brevity! content myself with the above examples: I think it will be allowed that there is a focussing of speculation from many adds in favour of "active" surface-growth -or, what is perhaps a better way of putting it, in favour of a belief that the extension of cell membranes depends on physiological rather than physical properties, that it is in some way under the immediate control of the protoplasm. We may take our choice between Wiesner's wall-protoplasm (dermatoplasm), protoplasmic intussusception as conceived by Strasburger, or the action of the ectoplasm in the manner suggested by Vines, who action of the ectoplasm in the manner suggested by vines, who supposes that the crucial point is a change in the motility of the protoplasm, not of the cell membrane. The latter theory would unidoubtedly meet the difficulties—if we could believe that so yielding a substance as protoplasm could resist the force of

ourgor.

The great difficulty is, as it seems to me, that since, e.g. in

Caulerpa, surface-growth is clearly due to stretching, as Noll has

an end since in camotic cell-pressure a stretching force does exist, it cannot be doubted that tungor, and ordinary physical extensibility are conditions of the problem. This remains true in spite of Klebs's (Tubingen Untersuchungen, it p 489) curious observations on the growth of plasmolyzed Algae, or 499) curious observations on the growin of plasmostzed raige, or in spite of the fact that pollen tubes may grow without tunger, in spite of the fact that pollen tubes may grow without tunger, in spite of the same being perhaps true of young cells filled with portoplasm (see Noll, Wurthung Arbeiten, ni. p 530). In the face of all these facts, osmotic pressure in the cell must remain a vera causa tending to surface growth.

If we accept some form of "active" surface growth, we must

' Sachi's 4 riesten, 15/2, and "Physiology," 1886 See also Gardiner, on protoplasmic crimtechtity in the Janual of Botany, i p. 366 Pfeiffer has think, shown the Viners and Gardiner's thorses assume the estience of to great aircraft in the exceptasm See Pfeiffer in Abhandl der k Sacks. Actalicit Nr. 1898, p. 329.

NO. 1130, VOL. 44]

deal with turgor in another way, although to do so may require a violent exercise of the imagination. Are we to believe, for instance, that the function of turgescence is the attaining of mechanical strength? If we hold that cell-walls increase in area mechanical strength? If we hold that cell-walls increase in area independently of turgor, we shall be forced to invent a hypothesis such as the following—which I am far from intending to uphold. It is possible to imagine that the function of the force of turgor is It is possible to imagine that the function of the force of turgor is morely to spread out the growing membrane to its full extent, and, as it were, but the control of the function of the fu by turgor (as in Mucor), instead of by brute strength of material, as in a tree-trunk, a great economy in cellulose is effected. If turgor played our hypothetical part of smoothing out the mem-brane and insuring that it shall occupy as large a space as possible, it would effect the same kind of economy.

position, it would effect the same kind of economy.

It is not necessary to inquire how far this hypothesis accords with our knowledge of cell mechanics. It is only put forth as an example of the difficulties in which we land if we seek for a new function for turgor. We are, indeed, surrounded by an example of the difficulties in which we land it we seek for a new function for turgor. We are, indeed, surrounded by difficulties; for, though the theories which are classed together as protoplasmic have much in their favour, they, too, lead us into an impasse.

Circumnulation.

I shall conclude by saying a few words about the theory o growth curvatures put forward in the "Power of Movement in Plants." I can here do no more than discuss the relation of circumputation to curvature, which is the thesis of the book in question, without attempting to enter the arena with regard to the many objections which have been raised to other parts of our

A distinguished botanist, Prof Wiesner, of Vienna, published in 1881 a book. "Das Bewegungsvermogen der Pflanzen," entirely devoted to a criticism of the "Power of Movement" emirety services to a criticism of the "Fower of Movement" (p. 8). It is founded on a long seriae of experiments, and is written throughout in a spirit of fabrices and candour which gives it value, apart from its scientific seclelince, as a model of scientific criticism. The words written on the tule-page of the copy, presented to my father are characteristics of the tone of copy pretented to my nature are characteristic of the tone of the book "In gertueur Opposition, aber in unwandelbaret Verchrung," A letter printed among my father's correspondence shows how warmly he appreciated his opponen's attack both as to matter and manner. Wesner's opposition is far-teaching, and includes the chief theoretical conclusion of the book and includes the Chief Incoretical conclusion of the book— namely, that movements such as heliotropism and geotropism are modifications of carcumatustion. Neither will be allow that this revolving nuttion is the widely-speeal phenomenon we held it to be According to Wiester, many parts of plants which do not circumsuate are capable of curving geotropically, &c., he is, therefore, perfectly justified, from his own point of view, in refuting to believe that such curvatures are derivations. from circumnutation He points out that our method of observing circumnutation is inaccurate, inasmuch as the movement is recorded in oblique projection. This we were aware of, and I recorded in oblique projection. This we were aware of, and I cannot but think that Wiesner has unintentionally exaggerated cannot but think that whether has uninenhally exagerated the inaccuracy, and that, if used with rea-onable discretion, it cannot lead to anything like such faulty records as in the suppositious eases given by our critic. However this may be, Wissner's results are perhaps more trustworthy than ours, and should roceive the most careful consideration

Wiesner's conclusions, taken from his own summaries, are as follows :---

The movement described as circumnutation is not a widespread phenomen in in plants. Stems, leaves, and acciliate fungi are to be found which grow in a perfectly straight line. Some roots grow for considerable periods of time without deviating from the vertical. When circumnutation does occur,

derating from the vertical. When circumputation does occur, it cannot be confideded to have the significance given to it in the "Power of Movement". The movement observed by Wiesser 1. As the expression of a certain irregularily in growth depending on the want of absolute symmetry in structure, and on the fact, that the component cells of the organ have not called the component cells of the organ have not called the component cells of the organ have not called the component cells of the organ have not certain organs have inherent tendendies to curve in definite plants—for instance, the benefiting of the hypocotyl in the plant of the component cells of the component of the plants—for instance, the benefiting of the hypocotyl in the plant of the component of the combined with others-heliotropic, geotropic, &c .- lead to

alternate bendings in opposite directions, according as one or other of the components is temporarily the stronger. iii. Wiesner allows that circumnutation does exist in some

in. Wrether allows that circumnutation does exist in some cases. This last class he considers a small one, he states, indeed, that "nearly all, especially the clearly perceptible circumnutations," are combined movements belonging to the second of the above estegories

Although I have perhaps no right to such an opinion without peating Wlesner's work, yet I must confess that I cannot give repeating Wlesner's work, yet I must confess that I cannot give up the bellef that circumputation is a widely-spread phenomenon,

even though it may not be so general as we supposed.

If, then, circumputation is of any importance, we are forced to ask what is its relation to growth-curvatures. It was considered by my father to be "the basis or groundwork for the acquireby my latter to be "the basis or groundwork for the acquire-ment, according to the requirements of the plant, of the most diversified movements" ("Power of Movement," p. 3) He also wrote (loc. cit., p. 4) -- "A considerable difficulty in the also wrote (ec. cit., p 4) — A considerable difficulty as the way of evolution is in part removed, for it might be asked how ind all these diversified movements . first arise? As the case stands, we know that there is always movement in progress, and its simplified, direction, or both, have only to be modified. for the good of the plant in relation to internal or external

Those who have no belief in the importance of circumnutatio and who hold that movements may have arisen without any such basis, may doubtless be justified in their position. I quite agree that movement might be developed without circumnutation having anything to do with the matter. But in seeking the origin of growth-curvatures it is surely rational to look for a ongin or grown-curvatures it surery random to look to a widely-spread movement existing in varying degree: This, as I believe, we have in circumputation and here comes in what seems to me to be characteristic of the evolution of a quality such as movement. In the evolution of structure, each indiwidual represents merely a single one of the units on which selection acts. But an individual which executes a number of selection acts. Dut an individual which executes a number or movements (which may be purposeless) supplies in itself the material out of which warious adapted movements may arise I do not wish to imply that tentative movements are of the same

I do no! with to imply that tentative movements are of the same order of importance as avariations, but they are undoubtedly of the problem may be taken back a stage further, we may ask why erroumulation should exist. In the "Power of Movement" (p. 546) we wrote—"Why every part of a plant whits it is growing, and in some cases after growth has cessed, should have its cells rendered more turgescent and its cell-walls more nave its delit rendered more lurgescent and its cell-walls more extensille first on one side them on another. Is not known of rest." Such periods of comparative rest are fairly harmonious with any theory of growth; it is quite concernable by intussis-ceptionists and appositionists alike that the two stages of elonga-tion and fixation should go on alternately. but this would not tion and fixation should go on alternately. but this would not not not not consume the of to circumstation. It might simply result in a confused struggle of cells, in some of which extension, in other and the confusion, was in the ascendant; but such a plan would be an about the confusion of th tion.2 Whether or no any such origin of circumnutation as is here sketched may be conceived, there can be no doubt that it

here aktched may be conceived, there can be no doubt that it had its origin in the laws of growth apart from its possible had its origin in the laws of growth apart from its spossible and its origin in the laws of growth apart from the law of the law of

NO. 1130, VOL. 441

such a power is nothing more than the heredity, which modifi-the embryo into the literates of its parent, and by a similar power massis that the shoot or root shall take on the straight form necessary to its specific character. But the two cases are not identical. The essence of rectipitality is the power of recovering from disturbance caused by external circumstance. When an organ has been growing more quickly on one side than another, the regulating power reverses this state of things and another, the regulating power reverses this state of things and brings the currying organ back towards the starting-point. We have the properties of the properties of the properties of the have the properties of the probable to ranging a type of trafti-ability which would insure growth being absolutely straight, but it is far more easy to conceive growth as normally made up-of slight departures from a straight line, constantly corrected In drawing a line with a pencil, or in walking towards a given point, we execute an approximately straight line by a series of point, we execute an approximately straight line by a series of corrections, If we may judge in such a nanner by our own experience.

If we may judge in such a nanner by our own experience, the such as the such know from experiments that a power exists of correcting excessive unlateral growth artificially produced, is it not probable that normal growth is similarly kept in an approximately straight line by a series of aberrations and corrections? If this is so circumuutation and rectipetality would be different aspects of

curcumutation and rectipetality would be different superes of the same thing when one interesting corollary is 7 we fix our attention on the regulating power instead of on the visible departures from the straight line, it is clear that we can imagine an irritability to internal growth-changes ensiting in varying the straight line would be corrected. With a lower trimbility the abternations would be greater before they are corrected. In one case the voluble movement of circumunitation would be very one case the visible movement of circumnulation would be very small, in the other case large, but the two processes would be the same. The small irregular lateral curvatures which Wiesner allows to exist would therefore be practically of the same value as regular circumnulation, which be considers comparatively

rare relation between rectipitality and circumnutution may be complified by an illustration which have conclusion and size of in lecturing on this point. A skild beyele rider runs very straight, the deviations from the desired course are comparatively small, whereas a beginner "wobbles" or deviates much But the deviations are of the same nature, both are symptoms of the regulating power of the rider

We may carry the analogy one step further just as growth curvature is the continuance or exaggeration of a nutation in a

we may cary too analogy one step turner just as growth curvature in the communities or seaggeration of a nutation in a so by will exaggeration of a "wobble". It may be said that curcumstations is here redeced to the rank of an accidental deviation from the right line. But this does not seem necessary, the texas. A beyele campo the reiden at allowed his wheel to run into a frozen rut. In the same way it is possible that some degree of curvam nation to correlated with growth in the manner suggested above, owing to the need of regular passes flag growth. Recupratily would than the a power and the same way it is not to be a power of the same way it is not to be a power of the same way it is not to be a power of the same way to be a same way to way to be a same way

in this field of research

NOTES.

THE German Leopold-Caroline Academy at Halle has conferred the degree of Doctor of Philosophy on the Director of the Royal Gardens, Kew.

MESSES. MACMILLAN AND Co. hope to publish before Christmas a series of popular sketches in the history of astronomy from the earliest times to the present day, in the form of a

Strasburger, "Histolog Beiträge," p 105, speaks of the pause th must occur after the formation of a cellulose launcila. Hofmesiare, "Farter being Jahreshife, 1874, describes the growth to length of Spir-gyra as me up of thort intervals of rapid growth alternating with long pauses of sit-

[&]quot;I purposely omis the elecumnutation of pulvini

volume containing three courses of lectures on astronomical biography by Prof. Oliver Lodge, F.R.S. The work will be fully illustrated, and will bear the title "Pioneers of Science."

Art the monthly meeting of the Fraid Naturalists' Club of Victions, held on July 43 jais, as we learn from the Melbourne Argust of July 14, Mearst. Luchman and Franch read a note and exhibated the skin of a tree-clubman kangawo from Northern Queensland, new to science, to which they gave the anne of Denderdagus muellers. This remarkable marsuplal has a body about two feet in length, with a tail somewhat exceeding two feet. The dispreporation between the fore leng and the hind leng is not nearly so great as that of the ordinary the support of the section o

IN his letter on "Dredging Products" (NATURE, August 23, p. 344). Mr. Alez Meek, writing from Sheland, gave a short **rimust of localities where Actinotrochs has been found, at the south coast of England was not mentifloned, Mr. W. L. Calderwood writes to call attention to a paper by his prodecessor at the M.B.A. Laboratory, Plymouth, Mr. G. C. Bourne, published to the Journal of the Marine Biological Association, vol. 1, No. 1. After mentioning the cocurrence of Tornaria, Mr. Bourne goes on to say —"Actinotrocha, the larva of Phoronia, is common. . . Several specimens of Jarral Amphicosis were taken in the tow-net towards the end of October." Invol. in. No. 1, Mr. Garatang also has a note on the coocurrence of the adult Phoronia. Actinotrocha has again appeared several times during the present summer.

M IMPELD, the Swiss engineer, who has been engaged to examine the nature of the summit of Mont Blanc for the construction there of M. Janssen's proposed Observatory, recounts in a Zurich journal the difficulties he is experiencing in his preliminary survey M. Imfeld is staying with eight workmen and two doctors at M. Vallot's Observatory, which has an altitude of 4400 metres, and thence they proceed daily to the summit, where they work for several hours a day in the endeavour to ascertain the depth of the snow for the purpose of getting the necessary foundation for the building M Eiffel has expressed the opinion that the construction of an Observatory will only be possible if the snow does not exceed a depth of 12 metres. M. Imfeld states that they have encountered traces of a ridge of rock 18 to 20 metres below the summit, and covered with about a metre of snow They have therefore commenced to make a series of lateral tunnels on three sides, at a distance equal to 12 metres below the summit, to ascertain if the ridge extends to that height. Progress is necessarily slow. Most of the men are suffering from mal de montagne Some, however, who are engaged at M Vallot's cabin are able to work almost as long as in the valley, and they also eat and sleep well. In spite of two coke stoves, the thermometer of the cabin never rises above zero; even ink freezes, and water bolls at 82°, and they cannot properly cook meat. For a day or two they were disturbed by violent storms.

MARTINIOUR has been visited by a terrible cyclone, the most volcent that has been known in the island since 1817. It lasted four boars, and was followed by an earthquake; and many lives were lost. According to the latest information received in Paris on Martinique on Monday hast, the number of persons known to have persished was 340 but that did not londed the sailors to have persished was 340 but that did not londed the sailor to have persished was 340 but that did not londed the sailor the number of persons known to have persished was 340 but the did not londed the sailor to have been sail to have

completely demolished. The town of Morne Ronge is said to be a total wreck, and Fort de France is almost entirely destroyed. Much suffering prevails among the population.

MESSER, L. REEVEAND CO. have in preparation a new work on the British Fangi, Phycomycles, and Utilingiene, by George Massee, Lecturer on Botany for the London Society for the Extension of University Texaching; a work on the British Heuughers. Heteropters, by Edward Saunders; a new work on the Lepsdopters of the British Islands, by Charles C. Barrett; and a new work on the physiology of the Invertebrats, by Dr. A. B. Griffishs.

MESSRS. WHITTAKER AND Co. are about to publish "A First Book of Electricity and Magnetism," by W. Perren Maycock. The work is intended for the use of elementary science and art and engineering students, and general readers.

MESSES. CASSELL AND Co. are issuing, in monthly parts, a new and revised edition of Sir R. Stawell Ball's well-known "Story of the Heavens" The first part has just been published, THE additions to the Zoological Society's Gardens during the past week include a Common Fox (Canss vulpes), British, pre sented by Captain H. S. Tunnard : five White-eared Conures (Conurus leucotis) from Brazil, presented by Mrs. Arthur Smithers : four Leopard Tortoises (Testudo pardalis), three Angulated Tortolses (Chersina angulata), a Galeated Pentonyx (Pelomedusa paleata), a Hoary Snake (Coronella cana), a Robben Island Snake (Coronella phocarum) from South Africa, presented by the Rev. G. H R. Fisk, C.M.Z S , two Alligators (Alligator mississippiensis) from Carolina, presented by Mr. Charles Downs, a Gold Pheasant (Thaumales picts 9) from China, presented by Mr. R. Hudson, a Pig-tailed Monkey (Maracus nemestrinus &) from Java, two Water Vipers (Cenchris piscivora)

SOCIETIES AND ACADEMIES.

from North America, deposited.

PARIS.

Academy of Sciences, August 17—M Decharire in the char—On a new blow-pipe, by M Faquitin—On "tyclic systems," by M. A. Ribastour.—New researches on the solar at mosphere, by M. H. Delalander, Gole Gour Antononical Golums)—nemples and the sameonus velocity of a solar prominence observed on the sameonus velocity of a solar prominence observed on the sameonus velocity of a solar prominence observed to the sameonus velocity of a solar prominence observed by M. Facy was about 325°. At once time the velocity of one portion of the group reached the high value of about 85° of the sameonus velocity of the sameonus velocit

CONTENTS.	AGE
The Congress of Hygiene	393
Letters to the Editor:-	
Rain gauges G. J. Symons, P.R.S.	398
Cloud Heights-Kinematic Method,-Prof. Cleve-	
land Abbs	398
The British Association	108
Section B (Chemistry)—Opening Address by Prof.	•
W. C. Roberts-Austen, C.B., F.R.S., Presi-	
dent of the Section	399
Section D (Biology)-Opening Address by Francis	
Darwin, M.A., M.B., F.R.S., Fellow of Christ's	
College, Cambridge, President of the Section	407
Notes	
Societies and Academies	776

THURSDAY, SEPTEMBER 3, 1891.

THE REPORT OF THE BOARD OF TRADE COMMITTEE ON ELECTRICAL STANDARDS.

ARDILY, and in a somewhat piecemeal if not grudging fashion, some small provision has been made by Her Majesty's Government for the regulation, under the Board of Trade, of the new but vigorous and rapidly-extending industry which recent developments of electrical science have brought into existence. In no previously-existing branch of trade has the problem of settling standards of measurement been so difficult of solution, and in no other has the problem been so completely solved without trouble, expense, or intervention on the part of the Government itself. For the last twenty-five or thirty years a Committee of the British Association has laboured at the gigantic task of building up a system of units, which involved as a mere preliminary the revision of the conceptions and units of dynamics in order that these might form a basis for the definition of units for the far more complex physical quantities concerned in electricity and magnetism, quantities many of which had previously been by no means clearly apprehended, and which then received for the first time precise statement and definition

Much of the work of the British Association Committee has been thankless, tedious, and, from its very nature. of a kind fitted to excite the cheap scorn of the self-styled "practical man," but it has made applied electricity possible, and has reacted in no slight degree on the progress of theory itself. The problem of the determination of the ohm-in other words, the process of realizing a standard of resistance according to the theoretical definition-has suggested problems to the theorist in the solution of which the theoretical investigator has been led to both direct and side-results of the very greatest value to the progress of science, and, in an unexpected manner, to the facilitation of practical applications. In no science have theory and practice been so closely connected during the last quarter of a century, and in none has the union been so markedly productive of good. By far the most interesting chapters of the history of electricity during the nineteenth century will be those that refer to its last three decades; may they chronicle a still closer alliance of the engineer and the experimenter, the electrical man of action and the mathematician ! Here union is strength and dominion over the forces of Nature : disunion is waste of energy and slow progress in all that relates to the material, and therefore also to the social, advancement of the human race by means of electrical invention.

The establishment of the nucleus of an electrical standardum; laboratory in London, and the appointment towards the end of last year of a Committee to decide upon and recommend for adoption electrical standards for use in trade, testify to the great importance which the electrical industries have attained in this country in spite of the mistakes which attended their inception, and the general discouragement and disfavour with which they were received by the various interests they threatened.

The preceedings and report of the Committee have just been published in a blue-book, which contains matter of great interest to all engaged in electrical work. The wrata which to opens up as regards the future operations of the standardzing laboratory may well diamay. Her Majesty's Government; although no doubt due provision will ultimately be made for all its work. But of this at another time; at present we wish to direct attention to the resolutions of the Committee, which will be found in another page.

In the first place the Commutee signify then adherence to the units of length, mass, and time as fundamental units, and adopt the C is S system. This was noty to be expected, for, after all, though some people may think that a better system could be devised if the work had to be done afresh, and they had a share in its still collectively the body of scientific opinion is distinctly conservative, and there is hitle danger that anylil-advised attempt to disarrange the accepted system of theoretical and practical units will success.

Their third resolution, that the standard of electrical resistance should be called the ohin and should have the value 1.000,000,000 in terms of the centimetre and second in the oidmary electromagnetic system, is of great importance It seems to settle once for all the question which has been debated over and over again, whether after a standard ohm has been realized, it will, like the standard yard or metre, be ever after the standard, or whether, if in case of variations in the physical properties of the substance, it shows an unexpectedly large divergence from the definition, a new standard ought to be constructed. Those who have assumed the former alternative have forgotten that the ohm is a derived unit. depending on the already fixed units of length, mass, and time, and that, therefore, its derivation ought to be as exact as the ever-widening resources of science can make it For practical purposes of trade the standard fixed

upon now and us copies are likely to remain undisturbed for a long time, and will probably only be corrected if there is serious alteration with time in their resistances. But the olim will still be defined as to C GS in the ordinary electromagnetic system of measurement, in which the magnetic permeability of air is assumed to be unity.

The fourth and fifth resolutions provide the definition of a practical realized ohm (1) by means of a column of mercury, (2) by comparison with the British Association until, which it is stated may be taken as 9866 of the ohm.

The wording of Resolution 4 strikes one as currous. The mercury column is to have a "constant cross-sectional area of 1 square millimetre" If "constant" has its ordinary sense of invariableness with time; the specification of 1 square millimetre renders it unnecessary. It has here apparently the usual sense of "uniform," that is, the section is the same at every part of the tube.

We are glad to see that the length adopted for the tround number adopted at the Paris Conference, and proposed, by the British Association Committee in 1889, by the British Association Committee in 1889 to be legalisted for a period of the ohm point to 106 3 as a convenient number very closely agreeing with the true value,

and its adoption now is probably only an anticipation of the decision which will be arrived at in a few years when the resolutions of that Conference are reconsidered.

In the adoption of a metallic working standard (announced in Resolution 5) the Committee only endorse an opinion long ago expressed by working electricians, that the mercury standards constructed in straight or spiral glass tubes are not practical instruments, they are difficult to handle, lable to breaked, and the only argument for their retention, the possible variability of metallic standards, has been shown to be almost baseless by the hosresults of the continued and careful observation of the various metallic resistance coils deposited at Cambridge-

Passing over the resolutions which provide for copies, and multiples and submultiples of the ohm, with the remark that the long-felt want of trustworthy standards of low resistance will now at last be supplied, we come to the definition of the unit of current Here again a theoretical definition corresponding to that of the ohm is given first . then for practical purposes it is stated "that an unvarying current which, when passed through a solution of nitrate of silver in water, in accordance with the specification attached to this report, deposits silver at the rate of 0 001118 of a gramme per second, may be taken as a current of 1 ampere" This is the most reasonable course that could have been adopted. The specification is practically one of the procedure adopted by Lord Rayleigh in his experiments on the electro-chemical equivalent of silver, and as Lord Rayleigh's absolute result was to be made the practical standard, it was right to recommend the same mode of experimenting

Resolution 11, which defines the ampere in the case of an alternating current, was the subject of a good deal of discussion, and of some adverse comment by one of the witnesses examined on behalf of the electrical trades The resolution states "that an alternating current of I ampere shall mean a current such that the square root of the time-average of the square of its strength at each instant in amperes is unit; " It was pointed out by the witness referred to, and by at least one member of the Committee, that this was giving a very special meaning to the term, one, moreover, inconsistent with the obvious definition, that of the simple time average of the current This latter average would, in the case of most periodic machines, be simply zero, unless the currents in the alternate half-periods were commutated so as to agree, in sign with those in the other h lves. But in the case of such a machine as the Brush, used for lighting incander cent lamps, the definition given in the resolution would have to be used, whereas if the machine were used for electro-plating, the simple time average would have to be employed This would give for the same current passing through the machine, from instant to instant, two different average values The electric lighting application of periodic machines is, however, by far the most important, and the Committee did well, perhaps, to retain what is already the generally understood sense of the word ampere in connection with alternating currents. It ought to be, however, clearly understood that the main application of the definition will be to the measurements of eurrents in electric lighting, and that generally in other cases another definition will have to be employed

Another important discussion took place over the

definition of the standard unit of "pressure." In the first place, we should like to say here that we object entirely to the use of the term "pressure" in this connection. It has come as a sort of analogue of hydraulic pressure, and it has certainly led to very erroneous notions in the minds of the general public as to the functions of electric supply mains, and also as to electricity itself. It is a pity that so many of the present pioneers of electricity who are also leaders of physical science. should have countenanced by their example this misuse of a scientific term. We all know how strenuously some of these gentlemen have objected to the term "lension" as in "high-tension electricity", surely "high-pressure instruments" and "electricity supplied at high pressure" are as objectionable, if not even more misleading. The use of the term voltage, or some such word, in the present Report, would have avoided the endorsement which it seems to give to what we think is a most unfortunate name for a physical quantity which is not a pressure at all, and it is to be hoped that the British Association Committee (who, by the way, were represented on the Committee of the Board of Trade) may be able to prevent this phrase from being added to the many other, though generally less objectionable terms which infest the literature of electricity

A discussion arose as to whether the definition of the volt as the " pressure which, if steadily applied to a conductor whose resistance is one ohm, will produce a current of one ampere," was sufficiently definite. There might, it was argued, be an internal electromotive force in the conductor, and the " pressure" applied to the conductor might be regarded as that applied from the outside. or actually existent between its terminals, as shown by an electrometer. For example, the conductor might be the aimature of a dynamo, the difference of potential might be considerable and the resistance only a small fraction of an ohm In such a case it is, of course, well known that the electromotive force producing the current through any part of the armature resistance, according to Ohm's law, is the total internal electromotive force of that part, minus the difference of potential existing between its terminals (both being taken positive), and it is the difference thus obtained that is to be regarded as the applied "pressure" of the definition. In the same way in a voltameter, the electromotive force causing the current, according to Ohm's law, would be the existent or applied difference of potential, minus the internal back electromotive force developed by the chemical action There were other difficulties about the specification of the ends of the conductor and the canalization of the current, and it was therefore thought desirable to adhere to the simple form of definition given in the report. It must be admitted that the definition leaves room for legal disputes in practice, and we think that it would have been perhaps better to have introduced on these points some kind of note or specification referred to in the resolution, so as to be taken along with it in the event of any dispute about the meaning of the definition

A further question arose as to the provision of a practical standard of electromotive force in the form of a constant cell; and it was decided, partly in deference to the expressed wish of practical electricians, that the Clark cell should be adopted for this purpose. Its electro-

motive force, within certain limits of error to be determined by a sub-committee appointed for the purpose of preparing a specification for the construction and use of the cell, is stated to be I 433 volts at the temperature 62° F. By means of this cell and known resistances, it will be possible to calibrate instruments without the use of electrolysis, and this to many persons would be the readiest and most easily carried out method Of course, logically speaking, the standard of electromotive force is settled when those of resistance and current are fixed. and thus, if the order of definition is adhered to, the cell does not come in But its electromotive force having been determined by careful measurement, and found to be so constant as it is, and so consistently the same in different specimens when the mode of construction is carefully attended to, it is too valuable a standard of reference to be set aside

A very interesting discussion took place as to the mode of preparing these cells, and on the experience of different investigators as to their behaviour. Some of the divergences stated in the discussion were probably due to the different degrees of manipulative skill possessed by the various observers. A few carful experiments with different batches of cells carried out personally by the members of the committee interested in the matter would set the question at rest, and probably entirely confirm Lord Ravleigh's marvellowly consistent results

A side-point which came out in discussion is worthy of notice. We have not in this country any legal definition of temperature, whether Centigrade or Fahrenheit In the definition of the standard yard 62° Fahrenheit is specified, but there is nothing to tell how that temperature is to be determined. It is well known (though apparently not to some of the text-book writers on heat) that mercurial thermometers, mide with different kinds of glass, while agreeing at the freezing and boiling points, agree nowhere else, and all differ more or less from the air-thermometer. In very accurate work these discrepancies become very important, and thermometers must be calibrated by means of standards, if their indications are to be of any use for comparison. Some legal definition of temperature will, ere long, have to be given, and it seems rather a pity that the Committee did not practically settle this by saying what they meant by 62' Fahrenheit.

The definition of the volt for alternating currents, embodied in Resolution 15, 18, of course, a mere consequence of Resolution 11, and these two definitions taken together are specially applicable to the measurement of the power spent in lighting incandescent lamps

We have only to note that the Committee, in Resolutions 12 and 16, adopted instruments on the principle of the balance for the measurement of currents, and on the principle of Str. William Thomson's quadrant electrometer, used idiostatically, for the measurement of differences of potential—except for large differences, when an electrometer on the principle of the balance is to be employed. Thus the beautiful electrometers invented long ago by Sir William Thomson are likely to become at last, in a modified form, Board of Trade standards of exact measurement in industrial electricity. This is by no means the only striking example which could be cited of the thoroughly practical, because thoroughly theo

retical, character of the instruments invented by one who understands all sides of the difficult problem involved in the invention and construction of scientific apparatus

No resolutions were framed by the Commutee on the very important subject of the measurement of power and energy. This must, however, come to the front before very long, and will tax the resources of the standardizing laboratory and its officials, avaisted, as no doubt they will be, by Committees such as this which has just reported We congratulate the Committee in the results of its blooms, and trust that the requires 6 'rider in Council will be passed before long confirming its resolutions. The bioborted will then be able to get to work, the necessary standards which have been asked for so long will be made accessible to those engaged in the electrical indistricts, accessible to those engaged in the electrical indistricts, and the control of the

THE CONGRESS OF HYGIENE.

WL print to-day a report of the important discussion in Section II (Bacteriology) of the Congress of Hygiene, on "Immunity, Natural and Acquired" —

Dr. Rous, of the Institut Pateur, in an untroductory address, midcased the scope of the discussion. If to began by saying that, mirriting a pupil of M. Pateur to open the discussion on this object, the Originamic Committee faul reminded the Section object, the Originamic Committee faul reminded the Section between the Committee of the Section of the Section of the Section of the Section of Origin, and preventive morehizen, the two subjects with which Mr. Patteur's ances would for all time to subjects with which Mr. Patteur's ances would for all time to subjects with which Mr. Patteur's ances would for all time to subject with the only way of confirming immunity by morehizen to the original of the virts of the disease. To the old diagresson submed of producing immunity by monitation, and the original original original of the term vacanison. The designation "attenuated" virtue ought to be reserved for virtual weakened without brain attenuated the term vacanison. The designation "attenuated" virtue ought to be reserved for virtual virtual original attenuated and the production of the production of the virtual volt the originalists of the production of the virtual volt the originalists.

Methods of Ittenuation —Two methods of attenuation had been described by M. Pasteur—namely, the prolonged exposure of a culture to are at a sustable temperature, and the passage of the macroorganisms through the bodies of different species of animals. Other methods had also been employed—for example, the action of heat, the use of antiseptice, of compressed oxygen and light.

In all cases, whatever the method employed, it was found to be necessary that the attenuation should be effected slowly and agadually, rapid attenuation rendered a virus sliegether mactive which was the state of t

tori of the Chemical studiance produced by the macro organisms to the Chemical with a constant of the Chemical with the

into sensitive animals, the greater the degree of refractorineas shown by the animal, the more rapidly the microbes were con-sumed by the leucocytes In a non-resistant animal the microbes remained free; no such phenomenon as phagocytosis could be observed It seemed, therefore, that the phagocytes were charged with the defence of the human organism, and entered into con-flict with the parasites which infected the human frame. It might be said that there were diseases in which the filterobes were to be met with in the cells specially, and that these microbes nevertheless proved fatal to the animal. In tuberculosis and in leprosy the bacilli were to be found in the cells, and the results leprosy the bacilli were to be found in life cells, and the results were of the nons zerous kind, in spite of line intense phagogotous induced by the much of these tassess. The fact proved that the property of the control of the co had conquered It was not sufficient that the microbes should be eaten up, it was essential that they should also be digested by the phagocytes Even in those cases where the struggle was going against the human organism, these cells still were the ssors It had been frequently observed in tuberculosis and leprosy that the bacili had been killed in the interior of certain of these cells. The theory asserted that a struggle occurred between the microbes and the cells, but it did not imply that the bacili always won the day Phagocytosis only occurred in immune animals, in animals susceptible to the disease it was either not to be observed, or it was incomplete.

He then proceeded to discuss the questions whether immunity was the consequence of this power of the cells to digest the virulent microbes As had been said, the cells of a refractory animal took up the microbes, which, it would appear, under favourable circumstances remained mert in the interior of the cells. Numerous facts had been alleged to show that the microbes

Numrous facts had been aliged to show that the microbes to the time they were taken up by the phagocytes were the time they were taken up by the phagocytes were fall activity. Thus, to take only one example, it had been found that in forgs the bacility which had been taken up by the lecoptes remained alive within the protoplasm of the cell, this was apparent from their movements. In Jumph taken from the body of a pigeon, numerous bacilit were to be seen imprisoned in the lenceytes, and these bacilit could be wrateful growing. actually under the eye of the observer, within the interior of dead phagocytes, they could be seen to elongate, to push out the protoplasm, distort the form of the cell, and finally to make their escape. Another demonstration of the importance of the action of the phagocytes was afforded by the fact that even in immune animals the microhes were found to increase when kept out of the reach of the leucocytes; thus, if a rabbit were kept out of the reach of the leucocytes; thus, it a rabbit were inoculated in the anterior chamber of the eye, where there were no cells, the bacteriagrew freely, and their development was only checked when the leucocytes had after a time migrated in large numbers, and began to take the microbes into their interior. numbers, and began to take the microbes into their interior. It thus appeared that phagocytosus was a very general phenomenon, and one which was very efficacious in checking the advance of the organisms; when it failed, the individual succumbed to the virulence of the bacteria. The question remained, What was the mysterious force which attracted the cells towards the microbes? Why were the leucocytes, which in immune animals destroyed the microbes, incapable of seizing upon them in non immune animals?

In 1883, Metchnikoff propounded his theory of phagocytosis This theory rested on two assumptions . first, that the cells were attracted to the microbes in virtue of a special sensibility manifested towards all foreign bodies introduced into the tissues; the second was that this power of seizing upon the virulent microbes in immune animals originated in a habit formed during the earlier straggle with the attenuated virus with which the animal had been previously inconalised. The behaviour of the leucocytes might be more readily explained by assuming that leucocytes had been property, analogies to that possessed by the soosperms of the myromyceter—anamely, that possessed by the soosperms of the myromyceter—anamely, that the possessed by the soosperms of the myromyceter—anamely, that microbe exerted a very marked chemical action on the phagories. Without a virus was introduced into the body, it pre-iderated, and secreted a substance which attracted the lesco-ries. When a scarte the virus was the controlled into the body, it pre-iderated, and secreted a substance which attracted the lesco-ries. When scarter the virus was the controlled with the proposed of the controlled were the power of the controlled with the controlled proposed of the controlled was the controlled proposed of the controlled was the controlled proposed of the proposed proposed of the proposed pr formed during the earlier struggle with the attenuated virus with

indepable of taking up the microbes, which therefore proliferated without hindrance. Further, in certain diseases the virus produced a substance which was still more poisonous. In chicken duced a substance which was still more poisonous. In chicken cholors, for misance, the posons secreted by the microbes repelled the leucocytes from the point of inoculation; it thus came about that phagocytes were never found in this particular affection. This, however, was not the case with animals which had been rendered immune either by inoculation. of the attenuated virus, or by the injection of a suitable dose of bacterial products If the animal were given a strong virus, phagocytes were attracted to the point of inoculation, and these possessed the power of taking up the microbes before they had time to elaborate effective doses of their toxic material. It was, therefore, at the commencement of the disease that the critical struggle took place. If the leucocytes could not the critical struggle took place. If the leucocytes could not as compilate his at the beginning of the malady, hear action as a fairer period would be useless, since the microbes would have profused enough posens to peralyze their activity. Every point of isocialision facilitated infection. The theory of immunity proponed by M. Metchikoff did not exclude the possibility of there being other means of protecting the organism, and it may prove the highest protecting the organism. The steme of the replace of the protecting the organism of the protecting the organism of the protecting the organism. It seemed to explain all the facts, and was, moreover, eminently suggestive. It was in this way that the knowledge of microbic polions and chemical inociation when the protection of the Far from being shaken by the theories which were opposed to it, this theory of Metchnikoff's had gained by the opposition which it has met, and that was a guarantee of its soundness

Dr. Buchner, of Munich, after giving a general account of the various theories of immunity, criticized freely Metchnikoff's views The main objections he brought forward were as follows .--

(1) Many observers failed to notice any destruction of bacilli

(a) In sup observers tasted to notice any oestimetion of oscillation by phagocytes, when naturally immune animals, such as white rats or pigeons, were inoculated with anthrax (a) In dis-asses ending fatally, such as tuberculosis, mice-septicemis, &c., the micro organisms were frequently found in the interior of plagocytes.

(3) The experiments of Petruchky, Baumgarten, Pekelharing, and others seemed to show that the bacilli of anthrax perished in the living fluids of immune animals even when the bacillt

were protected against the attacks of white corpuscles
Metchnikoff, however, denied this, and proved that the
living fluids of immune white rats form a most excellent cultivatliving fluids of immune white rais form a most excellent cultivating medium for the bacility of anithrax. These observations of Metchnikoff, according to Buchner, might be explained by the fact that Metchnikoff in his experiments introduced more bacilli than could be destroyed by the living fluids of white rais, occini inan count of netturyer of the invite interest of the extract of the state of the variety of micro-organisms. Speaking of the experiments made by his pupils benefit and Roeder, he stated that, when a certain kind of micro organisms were placed into a given quantity of serum, the nincro organisms might either be destroyed in toto, or reproduce themselves in large numbers according to the serum When, instead of placing the micro organisms directly serum when, instead of pincing the inter-organisms were wrapped up in sterilised coston wood, it was found that the bacilit, so protected against the temporary harmful influence of serum, began to grow luxurantly at the end of twenty-four hours. The bacterioidal power of serum disappeared, therefore, shortly after

Massart, Bordet, and Gabritchewsky had previously proved that the emigration of leucocytes to the spot where the virus was that the enligration of leucocytes to the spot where the vrust was introduced was due to the attracting influence (positive chemo-taxis) of the chemical posions secreted by micro organizas, but the thread the second organization of the control of the thread organization of the control of the control of the attracting influence on leucocytes was due to the products of present in bacterial cells themselve. Whereas the products of the metabolism of micro-organization had little or no attracting in-tenence on the lengocytes, the products in themselves suitarted the

fluence on the leucocytes, the proteins themselves attracted the cells most powerfully.

As long as the bacterial cells were active and capable of repro-ducing themselves actively, the proteins were contained in the cells, and these poisons only left the cells when the latter

became diseased or old Hence these proteins were chiefly found in old columns, the filtered and sternised extracts of which a lwfy pleased as time, strateling of leaves the color of the c the living fluids of the body exert a harmful influence on micro-organisms, and then, when in consequence of this the excretion

organisms, and then, when in consequence of this the exerction of proteins take place, the amenbod cells emgrate to the spots of the protein takes place that the protein takes the protein take the micro-organisms themselves, for, unless the latter were completely detroyed, they son began to grow friely in 'erum'. This germidial substance was easily destroyed by heat Serum which had been maintained at 55°C during half an hour, or at 52°C during six hours, lost its bactericadal power completely. A moderate degree of warmfit (37°C) intensified the germicalal

action of the blood or serum.

Turning now to the question as to whether this bactericidal ection of the blood had any share in the production of immunity, he gave the following facts as proving that there was some con nection between the immunity of a given animal against a given infectious disease, and the hactericidal action of its blood on the (a) The blood and scrum of animals, such as mice and guines

pigs, which readily succumbed to anthrax had no bactericidal power on anthrax-bacilli

(b) The serum of animals which took anthrax readily never possessed such a strong bactericidal action as the serum of white rats, which were immine against anthiax

(c) The blood and scrum of animals rendered artificially immune possessed stronger bactericidal powers than the blood

(d) The blood and serum of animals rendered artificially immune against a given micro organism lessened the virulence of the specific micro organism causing the disease

Whenever blood and serum possessed no hactericidal action on micro organisms, this absence of bactericidal action might be due to the fact that, owing to the necessary manipulations, this bactericidal substance had been altered or even

As further proving that the immunity of animals depended on some substance present in the serum, he mentioned the facts described by Behring, Kitasato, Ogata, and Emmerich, in which the injection of blood or serum of an animal immune against a given bacillu-, cured another animal afflicted with the same disease. This curative power he attributed to the presence in disease. In curative power is attributed to the present in the blood of immune animals of a protective substance, probabily proteid in its nature, to which he gave the name of "alexine" (from alexies, to protect). These alexines were not ordinary oxidation products of the tissues, as they were quite specific in ostuation products of the tissues, as they were quite specime in their action. They were not simply enzymes, as they had no hydrolytic properties, but they were most probably protect sub-stances. These alexines were probably formed in the cells; but, when formed, their action was quite independent from that of cells, and they were probably always present in immune animals

Mr. E. H. Hankin, of Cambridge, after giving a réumé of the work done by various observers, said that theoretical considerations led him to suspect that a particular ferment-like protects, known as cell globulin B, was a substance possessing bacterical power I let tested that action on anthrax bacilli, and found that I had the power of destroying these microbes. The control of t

only in animals that were naturally immune against anthrax, but also in those that were susceptible to this disease stances he had given the name of defensive proteids. To these sublished papers on this subject he had noted various similarities in the bactericidal action of these substances, and that possessed by blood serum, and these resemblances were such as to leave little room for doubt that the bactericidal action of blood-serum was due to the presence of these defensive proteids.

The serum of white rats contained a proteid body postessing a well-marked alkaline reaction, and a power of destroying an-intract bacilli. Further, when injected into mice along with fully virulent anthrax spores, it would prevent the development of the

On the other hand, defensive proteids of animals sus ceptible to anthrax did not exert such protective power, and ceptible to althrax did not exert such protective power, and consequently these experiments indicated a difference in the mode of action of defensive proteids of immune and non-immune animals respectively Further, the amount of defensive proteid present in a rat could be diminished by the causes which were known to be capable of lowering the animal's power of resisting anthrax. For instance, Feser stated that rats become succeptible to anthrax when fed on a vegetarian diet. Mr. Hankin obtained similar results with wild rats. The ordinary white rat he found to be generally refractory to antheax on any rat ne tound to be generally retractory to animax on any diet, and the defensive protest could always be obtained from its spleen and blood serum. This was not the case with wild In one experiment eight wild rais were used, of these, four were fed on bread and meat, the others on plain bread, for about six weeks Then one rat of each lot was inoculated with an were ted to meet a service of the death of the way inoculated with an thray, of these, the one that had been subjected to a bread diet succumbed. The remaining rais were killed, and it was found that while the spleens of the flesh fed rats contained abundance of the defenser protest, only traces of this substance could be obtained from the spleens of the rats that had been fed on bread obtained from the spleens of the rats that had been fed on bread the spleens of the rats that had been fed on bread the spleens of the rats that had been fed on bread the spleens of the rats that had been fed on bread the spleens of the rats that had been fed on bread the spleens of the rats that had been fed on bread the spleens of the rats that had been fed on bread the spleens of the rats that had been fed on bread the spleens of the rats that had been fed on bread the spleens of the rats that had been fed on bread the spleens of the rats that had been fed on bread the spleens of the rats that had been fed on bread the spleens of the rats that had been fed on bread the spleens of the s

aione A similar result was on-timed in other experiments. Very young rats were known to be susceptible to anthras, and so far as could be judged from the litmus text (after dialysis and addition of NaCl), their serum appeared to contain less of the defensive protect than did that of the adult sat. Further, the little from the little provided by a young rat could be preserved from the little from the little provided by the provided provided to the provided provided the provided from the little from the little provided the provided from the little from t anthrax by an injection of its parent's blood serum

These facts appeared to prove that the defensive proteid of the rat deserved its name, in that it preserves the animal from the attack of the anthrax microbe, in other words, that this substance was at any rate a part cause of the rat's immunity against anthrax

Defensive proteids appeared to be ferment like, albuminous bolies, and it was extremely unlikely that we should for a considerable time be able to classify them by any other than physiological tests. From this point of view it was possible to divide them into two classes, first, those occurring naturally in divide them into two ciasses, ints, into eccurring naturating in normal animals, and secondly, those occurring in animals that have artificially been made immune. For these two classes Mr. Hankin proposed the names of its arm and phylamen, A. "sound" was a defensive potent that occurred naturally in a normal animal. They had been found in all animals, jet examined, and appear to act on numerous kinds of intribusion on their products. A. "Phylistana" was a defensive protected which was only found in an animal that had been artificially made immune against a disease, and which (so far as is yet known) only acted on one kind of microbe or on its products

hach of these classes of defensive proteids could obviously be further subdivided into those that acted on the microbe itself, and those that acted on the poisons it generated. These suband those that acted on the pounds it generated. These sub-classes he probate to denote by a deling the prefices myos and classes he probated to denote by a deling the prefices myos and proteed occurring in the normal annual, which had the power of acting on various speecs of meroide. Two costans were idensity protests, also occurring in the normal annual, which is the probate of the probate of the probate of the meroide strength of the probate of the probate of the meroides. Myon phisars and too physicars maintaily would denote the two sub-classes of the physians graining two probates of the properties of the physians graining the sub-denote the two sub-classes of the physians grained to the desired control might be represented by the following

scheme :-



Prof. Emmerich, of Munich, read a paper on "The Artificial Production of Immunity against Croupous Paeumonia and the

Cure of this Disease." He stated that his previous experiments on swine fever had proved that in immune animals the bacilli of on swine fever had proved that in itimune authorized swine fever were destroyed, not by the cells of theanimal, but by a bacterickial substance present in the blood. It had been clearly proved by his experiments that the bacilli of swine fever were destroyed almost immediately after their introduction were destroyed almost immediately after their introduction under an immune animal's skin. Applying these researches to the disease produced in rabbits by the inoculation of the Diplocaccus premiums of Franchel, he showed that non-immune rabbits died within twenty four to forty-eight hours after the introduction of the virus. But if such animals had been preintroduction of the virus. But if such animals had been pre-viously treated with the blood or serum of animals rendered artificially immune against the diplococcus of Fraenkel, such animals did not die, but recovered after the introduction of extremely virulent diplococcu. Moreover, when the Diplococcus fricumonic was inoculated into an animal, it was possible to cure it by injecting shortly afterwards some of the serum of an animal rendered artificially immune. In the blood of animals amusin removed artificially immune. In the blood of animals rendered artificially immune against pneumonia we possessed an excellent cure for the disease. Not only would it be possible to cure men affilied with pneumonia by these injections, but we could, by preventive inoculations applied in time, put a stop to the spread of an epidemic in a school or a prison for instance His experiments, together with Dr. Doenissen's, had a great practical as well as a theoretical value

Dr Ehrlich, of Berlin, stated that he had lately made a number of experiments with ricin which threw great light on the question of immunity According to Kobert and Stillmark, ricin was an extremely poisonous body, for it acted fatally when such small doses as 0 03 mg were injected into an animal's veins. When absorbed through the alimentary canal, a dose 100 times larger could be easily tolerated. Nevertheless, even then, it was so toxic that, according to Kobert's reckoning, a dose of 0 18 gr would prove fatal to a full-grown man It had a harmful influence on the blood, producing coagulation of the red blood-corpuscles, and thromboses, more especially of the vessels of the alimentary canal

In his opinion the toxicity of ricin greatly depended on the in his opinion the toxicity of rich greatly depended on the species of animals used for experiments, the animals most susceptible to its action being quineapings. Thus, a guineaping weighing 385 grammes died eleven days after the inoculation of 7 cc of a 1 in 150,000 solution of rich, the fort most reason and the specific production is showing characteristic homorrhages in the allexamination showing characteristic influential transfer in the all-mentary tract. One gramme of this substance might therefore prove fatal to 1,500,000 guinea pigs. While mice, on the other hand, did not die after much larger doses, and this immunity of name, due not due after much larger doses, and this immunity of mice against this potton might be increased by sullicutaneous injections of ricin. The same result might be obtained, how-ever, far more essaly and without any chances of failure, by feeding mice with ricin. It was best to begin with mail, harmless doses, gradually increasing the amount until the or-ganism was accustomed to the poisonous substance. In ten days a mone might then be inoculated with a deadly or even days a moise might then be inocurated with a deathy of even larger dose without suffering any evil effects. Thus, whilst doses of 1/200000 gramme was absolutely fatal in normal animals, mice fed daily and in increasing quantities with ricin suffered no harm after the injection of 1/1000 gr or 1/500 gr.,

or, occasionally, of 1/250 gr

Whilst a 0 5 or 1 per cent solution of ricin applied to the eye of a normal animal produced severe inflammation and eye of a normal animal produced severe innammation ame panophilalmint; the application of a to per cent solution of ruen produced no effect on the eye of an animal previously fed with rein! In other words, this was distinct proof of the existence of a local a well as of a general innumity against the poison. Strangely enough it was almost impossible to render the subcutaneous tissue immune against ricin, and even in exceedingly immune animals the subcutaneous injection of ricin pro-duced distinct necrosis of the subcutaneous issue

It was a remarkable fact that this immunity appeared quite auddenly on the sixth day, and then increased slowly, so that on the twenty-figst day the animal could stand a dose which was 400 times higher than that fatal to a normal animal.

This immunity against item appeared to be permanent, for it was still present in immune mice which had not taken ricin for

a period of six months previously

He had been able to extract from the blood of animals rendered immune against ricin a body which had the power of counteracting the toxic action of ricin, so that a powerful solu-tion of ricin was rendered harmless by admixture with the blood

of immune mice. It was also possible to render animals immune against ricin by injecting the blood of immune animals. He had obtained similar results with abrin, which would be shortly published.

Dr. Kitasato, of Tokio, shortly summarized the results which he and Dr. Behring had obtained with the virus of tetanus.

According to these observers, the blood of a normal rabbit has no influence on the toxines secreted by the hacillus of tetanus. But when a rabbit had been rendered artificially immune against But when a rabbit had been rendered artificially immune against that disease, is blood had the power of destroying the toxine secreted by the specific bacillus. Nay, more, the blood of rab-bits made artificially immune against tenans with trichloride of todine, rendered mice not only refractory to telanus but also curred the disease when already in progress. The blood, how-ever, did not appear to act on the telanus bacillus itself, but on

ever, did not appear to act on the tetanus bacillus itself, but on the tormes secreted by the bacillus. The transposition of the Dr. Adams, of Cambridge, though that it was unpossible to the control of the control of the control of the control of phagocytosis was extraency marketins diseases the process it was quite possible to accept both views of the question. The controversy had taken place chefly as to the phenomen observed in the rat, in that animal phagocytosis was only to be observed with difficulty, and the serims of rat's blood unboulstelly pos-

bessed bacteria-killing properties to a high degree.

Dr. Klein, of London, stated that frogs and rats were mesusceptible to authrax, but that these animals could be made ceptible to authrax, but that these animals could be 'made susceptible to the disease by a variety of means, indicating that their normal power of resistance was due to certain chemical conditions of the blood. If the bacultus of anthrax was introduced into the lymph-sec of a chloroformed frog, this animal always duel of authrax. Rats incoulated with anthrax and kept under the influence of an anischetic also died of anthrax. If le had been unable to find any evidence to show that in these cases the leucocytes had lost their power of swallowing up bacteria, and therefore the susceptibility of chloroformed animals to anihrax could only be explained by some chemical changes taking place in the serum of the chloroformed rat or frog

Dr Metchnikoff, of Paris, who was greeted with loud and pro-longed cheering, said that, of all the objections which have been raised against the theory of phagocytes, doubless by far the most important was that formulated by Behring and Nissea. namely, the fact that the serum of guines-pigs vaccinated against the vibrio of Metchnikoff had bactericidal powers on the same vibrio. Whilst the serum of normal guinea pigs allowed the free development of a large number of these microbes, the serum of vaccinated animals killed the micro organisms at the end of a few hours. MM. Behring and Nissen were convinced that this fact formed a complete explanation of the acquired immunity of guinca-pigs against the Vierio Metchnikeli, and that it might serve as a model for a theory of immunity. His own researches, however, proved the contrary. If one studied the phenomena as they occurred in the living animal, one noticed at once that the hacili inoculated into immune guines pigs remained alive for a very long time. Some vibrios were taken into the interior of very long time Some vibrios were taken into the interior of leucocytes at the point of inoculation, whilst others developed perfectly in the liquid exudation. To show this, one had only to take a drop of the latter, and place it in the warm chamber, the leucocytes perished when taken out of the organism, and allowed the bacilli contained in their interior to develop freely.
The whrons thus multiplied and filled the leucocytes, which swelled and eventually burst, allowing the microbes to pass freely into the liquid part of the exudation

Here the development continued, and one obtained very abundant cultures from the liquid exudation of the immune guinea pig. If one ex-tracted a small quantity of such a culture, and introduced it into the dead serum of an immune guinea-pig, this serum not only did not kill the bacili, but also gave a more abundant development than the serum of a non-immune animal could do. The ment han the serum of a non-immune animal could do. The study of the phenomena in lying animals used artificially im-mune against the vibro of Metchnikoff, instead of overthrowing the theory of plagocytions, furnished on the contrary an evident proof in its favour. The theories of the attenuation of virus in the bodies of immune animals, and of the neutrilization of the totainer, could not be applied to his case, as the vibrour re-cording to the contrary of the proof of the country of the assectivity or the exercise of the bendling as the non-ingrussed as sensure to the toxine of the bacillus as the non-immune anımal.

This example showed yet once more that one must not be content with studying the phenomena of immunity outside the

(renewed)

8 16 0

^

ō

o

٥ ŏ ٥

^ ^

٥ a

This criticism also applied to M, Buchner's experiorganism. ments, which he had communicated to this meeting, he insisted on the fact that, in order to assure one's self thoroughly of the on the fact that, in order to assure one's self thoroughly of the betternical property of the sering, it was necessary to take a sering the ser ner. instead of furnishing an objection to the phagocyte theory, rather supported it

Referring to the curative properties of the serum of white rats against anthrax, he had come to the conclusion that, whereas the living serum of white rats had no bactericidal action on anthrax, the dead serum of the same animals had marked bactericidal powers on the same micro-organism. When a mouse was inoculated with a mixture of the dead serum of a rat and anthrax bacilli, it nearly always died, although the disease lasted somewhat longer than usual On examination of the point of inoculation it was found that the bacilli of anthrax did not grow quite so readily, and that an enormous number of leucocytes emigrated to the point of inoculation and took the bacilli into their interior and digested them In tetanus, again, the leucocytes are up con-siderable quantities of tetanus spores and bacilli. Summing up his researches, he stated that whenever an animal recovered from an infectious disease this recovery was accompanied by a process of phagocytosis, whenever an animal died of an in-fectious disease the process of phagocytosis was absent or insufficient. The theory of phagocytes was strictly based on the

After some remarks by Dr. Folor, Dr. Cartwright Wood, Pof. Bales, Dr. Wright, and Dr. Adsong, Dr. Martin, and Dr. Adsong, Dr. Martin, and St. daily, and the u e of the various vaccins manufactured at the

Dr Buchner congratulated Dr Metchnikoff on his most important paper. He was of opinion, however, that the time for framing a complete theory of immunity had not come yet Sir Joseph Lister then stated that if anything were required to justify the existence of this Congress it would have been their sitting that day. The immense amount of valuable material as to make all the members exceedingly grateful to those who had brought these matters before them

THE BRITISH ASSOCIATION

THE following is a list of the grants of money appropriated to scientific purposes by the General Committee at the Cardiff meeting, August 1891. The names of the members entitled to call on the General Treasmer for the respective grants are prefixed

A. - Mathematics and Physics

L s d *Foster, Prof Carey-Liectrical Standards (partly 27 4 6 renewed) *McLaren, Lord-Meteorological Observations on Ben Nevis 50 0 0 *Symons, Mr G. J.—Photographs of Meteoro-logical Phenomena

15 0 0

0

*Cayley, Prof.-Pellian Equation Tables (partly renewed)

15 0 0 *Rayleigh, Lord-Tables of Mathematical Functions 0 0 Fitzgerald, Prof. G F -Electrolysis š •

Lodge, Prof. -Discharge of Electricity from 1 50 0 0 *Thomson, Sir W -Seismological Phenomena of Japan 10 0 01

NO. 1140, VOL. 44

B .- Chemistry and Mineralogy. *Roberts-Austen, Prof - Analysis of Iron and Steel

*Armstrong, Prof H E -Formation of Haloids *Armstrong, Prof 11 E.—Formation of Haloids from Pure Materials (parlly renewed)

*Tilden, Prof W A.—Properties of Solutions

*Thorpe, Prof —Action of 1 ight upon Dyed Colours (partly renewed)

C - Genlary

*Prestwich, Prof —Frratic Blocks (partly renewed)
*Wiltshire, Rev T.—Fossil Phyllopoda (renewed)
*Geikie, Prof. J—Photographs of Geological 15 0 0 10 0 0 •

Interest 20 *Woodward, Dr H -- Registration of Type Specimens of British Fossils (renes ed) 10

*Hull, Prof E — Underground Waters
*Davis, Mr. J W — Investigation of Elbolton Cave
Jones, Prof R — Faunal Contents of Some by o 25 Zone 10 0 25 o

*Fvans, Dr J —Fscavations at Oldbury Hill *Woodward, Dr H —Cretaceous Polyzon

D - Budger

*Sclater, Dr P L -Table at the Naples /oplogical Station 100 0 0

Station

**Lankester, Mr. E. R.—Table at Plymouth Biological I ahoratory (renewed)

**Haddon, Prof. A. C.—Improving a Deep sea

**Tow-net (partly renewed)

**Newton, Prof.—Fauna of Sandwich Islands (te-17 10 0 40 0 0

new ed) 100 0 0 "Sclater, Dr P L —Zoology and Botany of the West India Islands (renewed)

100 0 0 F. - Geography

Ravenstein, Mr. E. G —Climatology and Hydro-graphy of Tropical Africa 75 0 0

II -Anthrofolo, y *Flower, Prof -Anthropometric I abordory 5 0 0

Garson, Dr J G — Prehistoric Remains in Mashonaland

*Tylor, Dr. E. B — North-western Tribes of 50 0 0

Canada 100 0 0 *Turner, Sir W —Habits, Customs, &c., of Natives of India (renewed)

10 0 0 *Flower, Prof -New Edition of Anthropological Notes and Queries 20 0 0

*Symons, Mr. G J -- Corresponding Societies' Committee 25 0 0

£1013 15 6 * Rrappointed

SECTION F

GEOGRATIIA. OPENING ADDRESS BY E. G. RAVENSTEIN, F.R.G.S., F.S.S., PRESIDENT OF THE SECTION

The Field of Geography

It behoves every man from time to time to survey the field of his labours, and to render an account unto himself of the work he has accomplished, and of the tasks which still await him, in order that he may perceive whether the means employed hitherto are commensurate with the magnitude of his undertaking, and likely to lead up to the desired results Such a survey of the "Field of Geography" I propose to make the subject of my address to-day

Whatever changes may have taken place respecting the aims of the geographer, it is very generally acknowledged that the rortrature of the carth's surface in the shape of a map lies within his proper and immediate domain. And there can be no doubt that a map possesses unique facilities for recording the fundamental facts of geographical knowledge, and that with a

Pressure on our space compels us to omit some parts of this a idress.

clearness and perspicuity not attainable by any other method. You will not, therefore, think it strange if I deal at considerable length with he development of cartography, more especially so my own labours have in a large measure been devoted to that department of geographical work. An inspection of the interesting collection of maps of all ages which I am able to place before you will serve to distinctive what I am about to say on this

subject...

It is all great reformers, stood upon the shoulders of the one who had preceded him, for before a map the he to could be the proceded him, for before a map the he could be produced much preliminary work had been accomplished. Parmenders of Elea (460 m c) had demonstrated that our earth was a globe, and Existinhenes (276-196 m c) had approximately determined us sure. Hipparchas (190-196) he greatest actionsomer of the standard produced to the contract of the standard produced to our earth the acultary lines standard by the standard transferred to our earth the acultary lines standard by the standard lines standard the standard produced to the standard lines standard the standard produced to the standard lines standard li

The gnome or van dial, an instrument known to the Chinese Goo years beine Christ, had long been used for the determination of latitudes, and the results were relatively correct, although uniformly subject to an error of 16 minutes, which was due to the observers taking the altitude of the upper limb of the sun, when measuring the shadow cast by their dial, instead of that of

the unis centre
It was known, likewise, that differences of longitude could be determited by the sumulaneous observation of eclipses of the san or moon, or of occulations of stars, and Ilpaperdus actually computations. Prolemy himself suggested the use of loars distances. But so imperfect were the astrolabes and other interferences are the sumulations of the sumulation of the sumulation

No copy of Fiolemy's original set of maps has reached us, for maps drawn by Agathodzmon in the fifth entury are, under the most favourable circumstances, merely reductions of Ptolemy's which apart from a few explanatory chapters, consains almost which, apart from a few explanatory chapters, consains almost modified to adopt the latter view—firstly, because of an almost inclined to adopt the latter view—firstly, because of rate exclastral survey was available, and accordity on account of the cylindract projection on which these maps are drawn, although from Ptolemy's own statements we are justified in the collections that the made due of a concoll projection on in the con-

The three longuades are the follows g -

| Result of ancient | Adopted by Actual difference | Actual differ

An examination of Polemy's maps above very clearly that they were almost wholly complete from internate, the greater number of which their subtle borrowed from his prediceases and an examination of the predicease are compiler cannot be rated very high, and that he failed to utilize much information of a geographical nature which was available in his day. His great merit consisted in having taught earlier graphers to constitute their maps according to a scentific method. This lesson, however, they were slow to lean, and centuries both the control of the co

During the "Dark Age," which followed the dimemberment of the found Empire there was no lack of range, but hely were utterly worthless from a scennife point of reew. The achievements of the accients were ignored, and the principal sum of the map-makes of the period appears to have been to the Holy Scriptures. Hence those numerous "wheel maps," upon which Jerusalem is unade to represent the hul, whilst the sectors half of the dask is assigned to Europe and Africa, and

As it is not my intention to introduce you to the archieological curiosities of an uncritical age, but to give you some idea of the progress of cartography, I at once pass on to the Arabis

Araba were great is traveller, greater nill a sutronomen, fully possessed of the knowledge of Ptolemy, throwest of the error of the gromon, the ymproved the nativanear when the promon the household of the promon, the household of the promon, the household of the promon of the promon of places. Zarkala, the Director of the Observatory of Toleda, even attempted to determine the difference to great a number of places. Zarkala, the Director of the Observatory of Toleda, even attempted to determine the difference to great a distance of the Control of § from the truth, it nevertheless proved a great advance upon Ptolemy, whose map exhibits an error anomating to 18. Had there existed as sentitific extregrapher among the Araba, he would have been able, distance made by exactful of never hie Araba Ilasan, to effect most material corrections in the map of the known world. If Edma's mag (154) is better than that of others of his Araba contemporaries, this is slipitly due to his residence at Federms, where he was table to sawd his need of the knowledge.

Quite a new epoch in the history of cartography begins with the introduction of the magnetic seeds into Juripe. Hitherto the mirroduction of the magnetic seeds in the Juripe. Hitherto heaves, themeforth an instrument was placed in his hands which made him independent of the uate of the sky. The property of the magnet or "loadintone" to point to the morth appeared to the morth of the property of the magnet or "loadintone" to point to the morth Alexander Neckam [1183] it was already possed upon a proct. It was, however, only after Theory Giospi of Ansail (1921) had the wands, that it became of such ammediate importance to the marner. It is only natural that the Italians, who were the foremost scamen of that age, should have been the first to avail date, as early probably as the twelfile centure, they made use of it for their maximume warveys, and in course of time they proceed a series of charts agon which the coasts frequented by which the coast frequented by the contract of the state of the

will prove this to you. The delineation of Italy, on the so called Catalan map, is surprisingly correct; whilst Gastaldo, whose map of Italy is nearly two hundred years younger, has not yet been able to emancipate himself from the overpowering authority of Ptolemy. And in this he did not sin alone, for Italian and other cartographers of a much later time still clung pertinaciously to the same error

ciously to the same error

There were others, however, who recognized the value of
these charts, and embodied them in maps of the entire world.

Among such were Marino Sanuto (1320) and Fra Mauro (1453),
both of whom made their maps the repository of much information gathered from the Arabs or from their own countrymen who had seen foreign parts. Fra Mauro, more especially has trans-mitted to us a picture of Abyssinia marvellously correct in its

matted to us a picurie of ADysums matteriously correct in its details, though grously engagerated in us timensions when the cartographers and pilots of Dortugal and Spain returned to the reade projection of Dicearach, Eratosthenes, and Marinus, which enabled them to lay down places according to latitude and longitude upon their "Plane charts."

Germany, debarred from taking a share in the great maritime discoveries of the age, indirectly contributed to their success by improvements in mathematical geography and the introduction of superior instruments. The manipators of the early middle

Lalande formed the basis of all astronomical calculations during a century, that more exact results were obtained. The suggestion to determine long tude by means of lunar distances or occul of stars bore no fruit at that time, as the knowledge of the com-plicated motion of the moon was still very imperiect. Still less picacea motion of the moon was still very imperfect. Still less was known about the movements of the satellates of Jupiter, which Galileo had first capied in 1610 when looking at that planet through his telescope. They became available only after tables of their revolutions and eclipses had been published by Cassini in 1668

Another suggestion for the determination of longitude was Another suggestion for the determination of longitude was made by German Fristus in 1530—namely, that a clock or time-keeper should be employed for the purpose. One of Huygens's pendulum clocks was actually carried by Holmes to the Guif of Guinea, but the results obtained were far from encouraging.

The difficulties which still attended the determination of origitude in the sixteenth century are conspicuously illustrated by the abortive attempts of a Congress of Spanish and Portuguese navigators who met at Badajoz and Yelves in 1524 for the purpose of laying down the boundary line, which Pope Alexander VI of laying down the boundary line, which Pope Alexander VI had drawn at a distance of 370 byanish leigues to the west of Cape Verde Islands, to separate the dominions of Spain from those of Portugal. Not being able to agree either as to the length of a degree, nor even as to that of a league, they separated without settling the question placed before their



ages still made use of an astrolabe when they deared to determine a latitude, but this instrument, which in the hands of an expert observer furnished excellent results on land, was of little use to a pilot stationed on the unsteady deck of a vessel use to a pitol statuored on the unateasy deck of a vessel Regiononians' conveyeently conferred as immerse service upon an instrument alterady known to the cordinary surveyors. It was this cross-staff which Martin Beham introduced into the Pottsguese navy, and which queekly made its way among the margation of all countries. Most observations a rea were course of ages, until it was superseded by Habiley's sextant. In the hands of the more shallin unarigations of the seventeenth entirely, such as Baffin, James, and Taman, the results obtained with the cross staff were correct within two or three manues. Far greater difficulties were experienced in the observations of with the cities and the west of the control of the parts 1474 to 1506, which Columbus carried with him on his voyages, nor those of Peter Apinans, for 1321-70, were sufficiently ac-curate to admit of satisfactory results, even though the setum tade were by no means are, and it was only which Replet had published his "Radolphire Tables" (1626), which according to NO. 1140, NO. 1441. Regiomontanus consequently conferred an immense service upon

So uncertain were the results of observations for longitude made during the sixteenth and seventeenth centuries, that it was thought advisable to trust to the results of dead-reckoning rather than to those of celestial observations. But the method of deadthought advanable to trust to the results of dead-resconing railer than to those of celestial observations. But the method of dead-reckoning is available only when we have a knowledge of the save of the earth, and this knowledge was still very imperfect, notwithstanding the resewed measurement of an arc of the meridate by Seellus, the Dutch mathematicism (1615). This measurement, however, is remarkable on account of its having for the first time applied the exact method of trangulation to a survey.

The problem of measuring the ship's way had been attempted by the Romana, who dragged paddle-wheels behind their ships, the revolutions of which enabled them to estimate the distance which the ship had travelled. But time, the strength of the wind, and the pilot's knowledge of the qualities of his ship, still constituted the principal elements for calculations of this kind, constituted the principal elements for calculations of flux kind, for the "catena a poppa" which Magellan attached to the for the "catena a poppa" which Magellan attached to the constant of 1577.

The eminent position which Italian cattographers occupied daming the fourteenth and fifteenth entimers had to be sur-rendered by them, in the beginning of the susteenth, to their rendered by them, in the beginning of the susteenth, to their properties of the control of the susteenth, to their properties of the control of the susteenth, to their properties of the control of the susteenth and the susteenth

"The German eartographers of that age are to be commended, not because they copied Ptolemy's mapped on its this they had been preceded by others—but because they adopted his scientific method in producing maps of their own. Their efforms began at home, as all reforms should. They were amply supposed as the commendation of the producing the producing

at a much later date.

Perhaps the earliest general map of Germany, and critality one of the most interesting, was that which the fimous Cardinal Nicolas of Cises or Clies completed in 1464, the only existing was "decovered" by Baron Nordenkulod Sercator's map of Germany, published more than a century after that of the learned certified (1614), was naturally far more complete in all recentually the control of the century of the control of the century of the century state of the century sta

by an inspection of a collection of maps to be found in the well income. The time Order of Collection of the Collection

Seasong the Durch earlographers of that age one of the formost places must be accorded to Waghener of Enkhussen, whose "Mirror of the Sea," a collection of charts published in 1528, eclipted a contuderable reputation among hirths seamen. 1528, eclipted a contuderable reputation among hirths seamen. Blactwa, and Vacher, who accumulated large stocks of copper places, which constituted valuable heritrooms, and, not unlike the plates of certain modern map-publishers, supplied edition that the date of the contract of the contract of the contract of the plates of certain modern map-publishers, supplied edition

The age of great ducovernes was past. All blanks upon our maps had not yet been filled up, but the contours of the great maps had not yet been filled up, but the contours of the great covernes on a large scale had, become upon the property in the Polar regions and in the laternor of some of the contoursts; but present prescribers had to be given to the work already done, and many detail remained to be filled in. In this "age of measurements," as Peckel significantly calls it, better instrainments and the present the

ments, and methods of observation superior to those which had sufficed hisherto, were needed, and were restily forthcoming. Frestil, I yearing use of the telescope in neutronia national forthcoming and the superior of the superior of the superior of the substitution of the superior of the theodolies, that most generally useful sun-regimentaries, and the superior of the seating, generally sacrible to I falled (1731), but in really due to the genus of Nexton. Equally important was the provided to the seating, generally sacrible to I falled (1731), but in really due to the genus of Nexton. Equally important was the provided to the seating, generally sacrible to I falled (1731), but in really due to the genus of Nexton. Equally important was the provided to the seating, generally sacrible to I falled (1731), but in really due to the genus of Nexton. Equally important was the provided to the contraction of the superior of the seating of the seating to the seating of the seating the seating to the seating position of celestral botter, but has already done excellent service in seating of cases the seating the se

sates of macessione mountains. But the full first, of these inventions could be enjoyed only after Bradley had discovered the aberration of light (1728) and after Bradley had discovered the aberration of light (1728) and first believe the sate of the forfaction of light; and the complexted movement of the moon had like its computed by Euler (1726). Tolks Mater (1754). Bradley (1770), and, more recently,

by Hansen

Possively novel methods for determining the latitude and longitude of a place can searcely be said to have been proposed during this period, but many of the older methods only locame really available after the improvements in the ins ruments indicated above had taken place, and the computations had been freed from the errors which visuated them formerly

The community of the co

Equally rapid have been the improvements in our instruments for measuring the depth of the ocean, since a knowledge of the configuration of its bed was demanded by the practical require ments of the telegraph engineers

And in proposition as the bibours of the inveyors and exports guarded in presenting the favults schewel in a minner fail more satisfactory than held been done have been been been failed as accretion presenting the favults schewel in a minner fail more statisfactory than held been done he copy for the with horizontal was comparatively easy so long as he only feelf, with horizontal manner of the mental properties of the cartily surface, however, presented far greater difficulties. The mode hills or servated ridges, which is the cartily relief altogether in dome playing to our actual knowledge. The first tund attempt to represent hills as seen from a bride sye way, and of shaling them according to the steepness of their slopes, appear on a map of the first guarded to the steepness of their slopes, appear on a map of the first guarded to the steepness of their slopes, appear on a map of the first guarded to the school of the steepness of their slopes, appear on a map of the first guarded to the discussion of the discussion of

correct nies on the configuration of the ground. The first to filly recognize the great importance of conteam. The first to filly recognize the great importance of conteam. The first to filly recognize the great importance of the first profitably be extended to a delineation of the relief of the land; and this idea, subsequently taken up by Ducaria of Values, was off the first times of the first times of the first times of the first times of the first time more than eighty methods of showing the hills have been advocated, but it may safely be asserted that none of these devocates of the safety of the first times more than eighty methods of showing the hills have been devocated, but it may safely be asserted that none of these

methods can be mathematically correct unless at as based upon horizontal contours

The crull of having dose most towards the promotion of entography in the course of the eighteenth century belongs to France. It was France which first equipped expeditions to determine the use of the earth. France which produced the first topographical map based upon scientific survey—a work began by Cear Françoi Cammin 11744, and completed by his son five years after his father's death, at was France, again, which would have very sentle, the first crucial carriage plane whom the world had ever sentle, the first crucial carriage plane whom the

Delide (1675-1736), a pupil of Casumis, had already been able to rectify the maps of the period by uttining the many astronomical observations which French Iravellers had Iraveller home from all parts of the world. This work of reform was carried further by 17 Arnollie (1675-1752), shot werent sawty the home to us the pretty of our knowledge, who boldly refused to believe in the eavience of an Antarctic continent covering all the southern benutyhere, and always brought stoond jurig ment to bear upon the materials which the over increasing ment to bear upon the materials which the over increasing eight the southern and the south

In that country the discovered of Cook and of other famous mergators, and the spread of Blush power in floids, gave the first impairs to a more diligent cultivation of the art of representant in the surface of the earth on many. There, to a general extent into exhetence a wast number of charts, amongst which are many bundred of these published by Dalympide and looped Debarred by the property of the property of

mandate in the property of the present century Germany has once more become the head quarters of sentific caterography, and this is due as much to the inspiriting teachings of a fixiter and a litembodit as to the general culture and selection training, common the property of the proper

And now, at the close of this nineleenth century, we may fairly boast that the combined science and skill of surveyors and cartographers, aided as they are by the great advance of the

graphic arts, are fully equal to the production of a map which abili he a faithful image of the earli's surface. Let us linegare for one moment that an ideal map of the kind were before us, a map exhibiting not mently the features of the land and the depth of the sas, but also the extent of forests and of pasture lands, the distribution of human habitomos, and all those features the distribution of human habitomos, and all those features the physical and statistical altises. Let as then analyze the rais mass of facts that pleaced before us, and use shall hud that they form quite naturally two well-defined divisions—namely, those of physical and political geograph—whils the third department of our science, mathematical geograph—whils the third department of our science, mathematical geograph—with the third department of our science, mathematical geograph—will introduce of which is

"I shall abstain from groung a laboured definition of whal I consider geography should enhance, for definition of this kind help practical workers but luttle, and will never deter anyone who feels duponed and capable from straying into feels which an absets of lege that clearly demonstrated to lie outside his an absets of lege that clearly demonstrated to lie outside his and chorography, the description of particular places or of entire countries, should always be looked upon as integral portions of geographical research. It is they which farmish many of the blooks needed to rear our geographical editine, and which combined the contribution of pactical processing and the contribution of pactical geographical editine, and which combined the countries of pactical eccentricity.

That our maps, however elaborate, should be supplemented by descriptions will not even be gain-and hythose who are most reluctant to grant as our independent extender among the sences which deal with the cartin and mm who mibalis at villow ourselves to be reduced to the post on of collection, of facts. We claim the right to discovery ourselves the facts we have collected, to analyze them, to generalize from them, and to trace the correlations between came, and effect. It is thus that geography hecomes comparative, and white comparative the citing sufficient features of our earth, comparative the citing suffice features of our earth, comparative of the confidence of the

smooth was of multiply califyrated by level letter. Man is indeed in a large neasure "the creature of his environment," for who can doubt for a moment that geographical conditions have largely influenced the destinate of rutions, laved directed the builders of our towns, determined the paths of nungrations and the march of armies, and have impressed their value pere upon the character of those who have been subjected to them for a sufficiently extended period?

It must not, however, he assumed for one moment that the dependence of man upon Nature is abolute. The natural recourses of a country require for their full development a people of energy and capasity, and instances in which they have been allowed to the dormant, or have been wasted, are

Perhaps one of the most instructive illustrations of the complete human agencies which tend to modify the claitive importance of geographical conditions is presented to us by the Mediterranean of the world's commerce, whilst the horses of Western Europe were only occasionally vasited by venturesome navigations or onspering Roman hosts, does not lie so very for behind us, or onspering Roman hosts, does not lie so very for behind us, Europe, of which it was a mere dependency. The prosperity of the Mediterranean countries survived far into the middle ages, and faily at one time enjoyed the envalde position of the Mediterranean countries survived far into the middle ages, and faily at one time enjoyed the envalde position of the Mediterranean countries and to Germany, and through the gates of Gibnaltar to the exterior occan. But a change was brought shost, partly through the closing of the old Criential through the discovery of a new world and of a mantime highway to India. When Columbas, hisself an Islain, returned from the West Indices in 1493, and Vasco da Gama brought the fair face. And shifts the speec of the Indies and the gold of Gunes powerd wealth into the lap of Portugal, and Spain grew quient on the ulter mass of Mexico and Pens, Vesico was

valuly beseething the Sultan to reopen the old trade route through the Red Sea. The dominion of the sea had passed by the Red Sea. The dominion of the sea had passed by the Red Sea. The dominion of the Red Sea Red and political institutions found a home in a new world

and pointest institutions town a nome in a new world.

And now, when the old highway through the Red Sea has been reopened, when the wealth flowing through the Canal of Secz is beginning to revivily the commerce of Italy, England may comfort herself with the thought that in her own colonies and in the States which have sprung up across the Atlantic she may find ample compensation for any possible loss that may accrue to her through geographical advantages being once more allowed to have full play

I am afraid I have unduly tried your patience. I lelieve you will agree with me that no single individual can be expected to master all those departments which are embraced within the wide field of geography Even the mater mind of a Humboldt fell short of this, and facts have accumulated since his time at an appalling rate. All that can be expected of our modern geographer is that he should command a comprehensive general view of his field, and that he should devote his energies and capacities to the thorough cultivation of one or more departments that he within it.

SECTION II ANTHROPOLOGY

OPENING ADDRESS BY PROF F MAX MILLER, PRESIDENT OF THE SECTION

If was forty four years ago that for the first and for the last time I was able to take an active part in the meetings of the British Association for the Advancement of Science. It was at British Association for the Advancement of Science I was at Oxf.ord, in 1847, when I read a paper on the "Relation of Ben-gal to the Asyan and Aboriginal Languages of India," which received the honour of being published in full in the Transac-tions of the Association for that year I have often regretted that absence from England and pressure of work have prevented me year after year from participating in the meetings of the Asso-ciation Bath, being a citizen of two countries—of Germany by hirth, of England by adoption-my long vacations have gener ally drawn me away to the Continent, so that to my great regret I wonder whether any of those who were present at that bril-

liant meeting at Oxford in 1847 are present here to-day I almost doubt it. Our President then was Sir Robert Inglis, who will doubt it. Our Fresident then was Sir Robert ingits, who will always be known in the annals of English history as having been preferred to Sir Robert Peel as Member of Parliament for the University of Oxford. Among other celebrities of the day I remember Sir Roderick Murchison, Sir David Brewster, Dean Buckland, Sir Charles Lyell, Prof. Sedgwiek, Prof Owen, and many more—a galaxy of stars, all set or setting. Young many more—a galaxy of stars, all set or setting. \(\)
Mr. Ruskin acted as Secretary to the Geological Section Section was then not even recognized as yet as a Section. We ranked as a sub-Section only of Section D. Lorlogy and Bolary ranked as a sub-Section only of Section 13, Lordings and Hadary We remained in that subordinate position till 1831, when we became Section E, under the name of Gorgeraphy and Ethnology. From 1869, however, Ethnology seems almost to have distilled the substitution of the substitution of

General I was invited to join the meeting by Bansen, then Prussian Minister in London, who also brought with him his Iriend Dr. Karl Meyer, the Celuc scholar Prince Albert was

present at our debates, so was Prince Louis Lucien Bonaparte.

Our Ethnologueal sub-Section was then most popular, and
When looking goos more through the debates carried on in
our Section in 1847, I was very much surprised when I aws how
very like the questions which occupy as to-day are to those
which we discussed in 1847. I do not mean to say that there
has been no selvance in our science. Far from it. The advance has been no advance in our science. Far from it. The advance of linguistic, ethnological, anthropological, and biological studies, all of which claim a hearing in our Section, has been most rapid. Still that advance has been steady and austained, most rapid Sill that advance has been steady and austained, there has been no cataclyam, no deluge, no break in the advancement of our science, and nothing seems to me to prove its healthy growth more clearly than this uninterrupted continuity, which unites the past with the present, and will, I hope, unlie the present with the future.

No paper is in that respect more interesting to read than the address which Bunsen prepared for the meeting in 1847, and which you will find in the Transactions of that year. Its title is "On the Results of the recent Egyptian Researches in

life is "On the Kesuit of the recent Egyptian Kesearches in reference to Assate and African Litnology, and the Classifica-tion what this title would lead you to expect. There are peed deal more than what this title would lead you to expect. There are pessades in it which are truly prophetic, and which show that, if prophety is possible anywhere, it is possible, any, it ought to be possible, in the temple of Science, and under the

inspiring influence of knowledge and love of truth
Allow me to dwell for a little while on this remarkable pape Allow me to dwell for a hitle while on hits remarkable paper Is it rue, we have travelled no kin this bisuare neural amost to belong to accord history. This very year is the hundredth ambits being close accord history. This very year is the hundredth ambits being celebrated in several towns of Germany. In England also hit memory should not be forgotten. No one, not being an Englishman by both, could, I believe, have loved this county more warmly, and could have worked more heartily than Bluesten did to bring about that frendship between Englishman Bussen did to bring about that frendship between Englishman Bussen did to bring about that frendship between Englishman Bussen did to bring about that frendship between Englishman Bussen did to bring about that frendship between Englishman Bussen did to bring about that frendship between Englishman Bussen did to bring about that frendship between Englishman Bussen did to bring about that frendship between Englishman Bussen did not be the second that the second tha than bursen due to oring anough that triendship between Eng-land and Cermany which must for ever remain the corner-stone of the peace of Europe, and the une quid non of that advance-ment of science to which our Association is devoted. His house in Carlton Terrace was a true international academy, open to all who had something to say, something worth listen ing to, a kind of sanctuary against vulgarity in high places, a neutral ground where the best representatives of all countries were welcome and felt at home. But this also belongs to were welcome and left at nome Datt this also belongs to ancient listory. And yet, when we read Bunsen's paper, delivered in 1847, it does not read like ancient history. It deals with the problems which are still in the foreground, and if it could be delivered again to-day by that genial representative of German learning, it would jouse the same interest, provoke the same applause, and possibly the same opposition also, which it roused nearly half a century ago Let me give you a few in-stances of what I mean.

stances of what I mean.
We must remember that Darwin's "Origin of Species" was
published in 1859, hit "Decent of Man in 1871. But here in
causes in the question of the possible direction of man from some
unknown annual. He traces the history of that question back
to Frederick the Great, and quotes his memorable asswer to
D'Alembert. Frederick the Great, tyou know, was not disthe control of the possible of the control of D'Alemiert. Frederick the Great, you know, was not dis-turbed by any qual-mot orthodoxy. 'In my knegdom,' he used to say, "everybody may save his sool according to his own fashion." But when D'Alembert wished him to make what he called the salts merials from monkey to man, Frederick the called the salts merials from monkey to man, Frederick the when the salts of the salts of the salts of the salts of the which no sunnal can clear, ow which, at all events, not, and that with all the likeness of their bodily organs there is a barrier which no sunnal can clear, ow which, at all events, no animal has any set cleared. And what does Bussen himself consider the real lawrier between man and beats." 'Il is a language,' the says, except man." In natwer to the argument that, given only a sufficient number of years, a transition by imprecipible degrees except man." In answer to the argument that, given only a sufficient number of years, a transition by imprecipible degree from animal circs to articolate language is at least conceivable, the says, —"Those who hold that to pinson have never been able to show the possibility of the first step. They attempt to veil their inability by the easy but fruitless assumption of an infairte space of time, dettined to explain the gradual development of animals into men, as if millions of years could supply the want of the sgent necessary for the first movement, for the first step, in the line of progress. No numbers can effect a logical impossibility.

How, indeed, could reason spring out ot a state which is destitute of reason? How can speech, the expression of thought, develop itself, in a year, or in millions of years, out of inarti-culate sounds, which express feelings of pleasure, pain, and

appetite?"

If then appeals to Wilhelm von Humboldt, whom he truly

of almost all He then appeals to Withelm on Humboldt, whom he truly calls the greatest and most acute annioms of almost all human speech Humboldt goes so far as to say -- "Hather than sasign to all language a uniform and mechanical march that would lead them step by step from the grossest beginnings to their highest preference, I should embrace the opinion of those who sarribe the origin of language to an immediate revelation of the step of the ste which shines through all idioms, even the most imperfect and

Bunsen then sums up by saying: "To reproduce Monboddo's theory in our days, after Kant and his followers, is a sorry ana chronism, and I therefore regret that so low a view should have been taken of the subject lately in an English work of much correct and comprehensive reflection and research respecting correct and comprehensive renection and research respecting matural science." This remark refers, of course, to the "Vestiges of Creation" (see an article in the Edinburgh Review, July, 1843), which was then producing the same commotion which Darwin's "Origin of Species" produced in 1859
Bunnen was by no means unaware that in the vocal expression

of feelings, whether of joy or pain, and in the imitation of external sounds, animals are on a level with man "I believe with Kant," he says, "that the formation of ideas or notions, embodied in words, presupposes the action of the senses and impressions made by outward objects on the mind But," he adds, "what enables us to see the genus in the individual, the impressions name of source and source and the individual, the adds, "what enables us to see the genus in the individual, the whole in the many, and to form a word by connecting a subject with a predicate, is the power of the mind, and of this the brute

creation exhibits no trace."

You know how for a time, and chiefy owing to Darwin's perdominating influence, every concernable effect was made to
exhibit the control of the control of the control
beats, and to treat language as a wanhung line in the medial
evolution of animal and man. It required some courage at times
to stand up against the authority of Darwin, but at present
all serious thinkers agree, I believe, with Bussen, that no
animal has developed what we mean by rational language, as distinct from mere utterances of pleasure or pain, from imitation of sounds and from communication by means of various signs, a of sounds and trom communication by means of various signs, a subject that has listely been treated with great fullness by my learned friend Prof. Romanes in his "Mental Evolution of Man" Still, if all true science is based on facts, the fact remains that no animal has ever formed what we mean by a language, and we are fully justified, therefore, in holding with Bunsen and Humboldt, as against Darwin and Prof Romanes, that there is a specific difference between the human animal and all other animals, and that that difference consists in language as the outward manifestation of what the Greeks meant by Logor.

, Another question which occupies the attention of our leading Another question which occupies the attention of our reading anthropologists is the proper use to be made of the languages, customs, laws, and religious ideas of so-called sevages. Some, as you know, look upon these modern savages as representing human nature in its most primitive state, while others treat them. as representing the lowest degeneracy into which human nature may ank. Here, too, we have learnt to distinguish We know that certain races have had a very slow development, and may, therefore, have preserved some traces of those ample institutions. which are supposed to be characteristic of primitive life. But we also know that other races have degenerated and are degenerat-ing even now. If we hold that the human race forms but one species, we cannot, of course, admit that the ancestors even of the most savage tribes, say of the Australians, came into the word one day later than the ancestors of the Greeks, or that they passed through few or evolution than their more favoured brethren. The whole of humanity would be of exactly the hand the state of the world one day later than the ancestors of the Greeks, or that

savage is justly disclaimed as the prototype of natural, original man; for linguistic inquiry shows that the languages of savages are degraded and decaying fragments of nobler formations.

I know well that in unreservedly adopting Bannen's opinion on this point sho I run counter to the teaching of such well-known writers as Sir John Lubbock, Reclus, and others. It might be supposed that Mr Herbert Speacer also looked upon savages as representing the primitive state of mankind But if he ever did so, he certainly does so no longer, and there is nothing I admire so much in Mr. Herbert Spencer as this simple nothing I admire so mucu in Air, I retrieft spencer as times include love of truth, which makes him confess openly whenever he has seen occasion to change his views "What terms and what conceptions are truly primitive," he writes, "would be easy if we had an account of truly primitive men. But there are sundry we mad an account of truty primitive men. But there are sainly reasons for suspecting that existing men of the lowest type form-ing social groups of the simplest kind do not exemplify men. men as ing social groups of the simplest state of them, if not all, had ancestors in a higher state" (Open Court, No. 205, p. 2896)

Most important also is a hint which Bunsen gives that the

students of language should follow the same method which has been followed with so much success in geology, that they should been followed with so much success in georogy, and then apply been with studying the modern strata of speech, and then apply the principles, discovered there, to the lower or less accessible strata It is true that the same suggestion had been made by strata It is true that the same suggestion has been made by Leibniz, but many suggestions are made and are forgotten again, and the merit of rediscovering an old truth is often as great as the discovery of a new truth This is what Bunven said: "In order to arrive at the law which we are endeayouring to find (the law of the development of language) let us first assume, as geology does, that the same principles which we see working in the (recent) development were also at work at the very beginning, modified in degree and in form, but essentially the same in kind We know how fruitful this suggestion has proved, and how We know how fruitful this suggestion has proved, and now much light an accurate valy of modern languages and of spoken dialects, has thrown on some of the darkest problems of the scenece of language. But fifty years ago it was Sanakit only, or Hebrew, or Chinese, that seemed to daserve the attention of the students of comparative philology. Still more important is Bunner's next remark, that language legins with the sentence, and that in the beginning each word was a sentence in stell. has used in the originating each word was a sentence in itself. This view also has found strong supporters at a later time—for instance, my friend Frof Snyce—though at the time we are speaking of it was hardly thought of I must here once more quote Euneen's own words. "The supreme law of progress in all language thows itself to be the progress from the substantial an inaguage snows itscil to be the progress from the shoutantal isolated word, as an undeveloped expression of a whole sentence, towards such a construction of language as makes every single word subservient to the general idea of a sentence, and shapes, modifies, and dissolves it accordingly."

modifies, and dissolves it accordingly."

And again "Every sound in language must originally have heen significative of something. The unity of sound (file syllable, pure or consonantised) must therefore originally have corresponded to a unity of conscious plastic thought, and every thought must have had a real or substantial object of percep.

corresponds to a turn of conscious principal control c fires, and unfares The modern school maintained that there crusted entire roots by themselves no suffice, preferee, and infared by themselves, and that the theory of aggluttation—understanding the control of the cont

and therefore significative, that they are the remnants of pre-dicative or demonstrative words. It is true we cannot always prove this as clearly as in the case of such words as hard-shap, wors-dom, man hood, where hood can be traced back to hold, instruction, must hard, where Asset can be traced back to Add, which in Anglo Savion crassis as an independent word, meaning which in Anglo Savion crassis as an independent word, meaning in a determinant, claim-resent, continuer to exist by stell, as when we say in Sapansh dorse, concess y dependented: I as perfectly tree that the Preach, when they say that a hammer shill domedic originally the Latin mostel, "with a simil "—and give it to their adjective Instal Here the new school has done good service in showing the working of that united of analogy which continues the same of the same properties of the same of the same properties." is a most important element in the historical development of human speech. One compound was formed in which mente retained its own meaning; for instance, forti menti, But when this had come to mean bravely, and no brave mind But when this must could be installed. In more, the working of analogy began, and if fortement, from fort, could mean "bravely," then why not louidment, from lourd, "heavily?" But in the end there is no escape from Bunsen's fundamental principle that everything in language was originally language—that is, was significative, was substantial, was material
—before it became purely formal

But it is not only with regard to these general problems that But it is not only with regard to these general problems that But it is not only with regard to the general problems for some of a superior of the superior of the superior of the right when many of his contemporaries, and even successor, were evong I has long been a question, for mutance, whether the Armenan language belonged to the Iranic branch of the Sunkrit, Fernan, or Greek Bunnen, in \$45, retarded Armenan as a separate branch of Aryan speech, and that it is so was proved by Prof. Histochaman in \$63, such whether his names to the superior branch of Aryan speech, and that it is so was to the superior branch of Aryan speech, and that it is so was to the superior branch of the superior superior superior branch superior sup

proved by Prof. Hulschmann in 1833.
Again, three has been a long onclusive symbolic the language Again, three has been a long onclusive or the Inneh Bunch. Dr. Trumpp timed to thow that it belonged, by certain peculiaries, to the Indice or Sanakrine branch. Prof. Darmeelster has proved but lately that it shares its most essential characteristics of the Indice of t

I hope you will forgive me for having detained you so long ith a mere retrospect. I could not deny myself the satisfaction with a mere retrospect with a mere reirospect of paying this tribute of grantitude and respect to my departed friend, Baron Bunsen To have known him belongs to the most cherished ecollections of my life. But though I am myself an old man-much older than Bunsen was at our meeting in 1847—do not suppose that I came here as a mere landator tempora act. Cerianly not. If one trea to recall what anthropology was in 1847, and then considers what it is now, antiropology was in 1247, and tien considers was it is now, its progress seems most marvellous I do not think so much of the new materials which liave been collected from all parts of the world. These last fifty years have been an age of discovery in Africa, in Central Asia, in America, in Polynesia, and in Austialia, such as can hardly be matched in any previous

But what seems to me even more important than the mere increase of material is the new spirit in which anthropology has been studied during the last generation. I do not mean to depreciate the labours of so called dilettants After all, dilettanti are lovers of knowledge, and in a sludy such as the study of anthropology the labours of these volunteers, or franc tircurs, have often proved most valuable. But the study of man in every part of the world has ceased to be a subject for curroutly only. It has been raised to the dignity, but also to currosity only It has been raised to the dignity, but also to the responsibility, of a real science, and it is now guided by principles as strict and as rigorous as any other science—such as zoology, botany, mineralogy, and all the rest Many theories which were very popular fifty years ago are now completely exploded, nay, some of the very principles by which our science was then guided have been discarded. Let me give you one

was the guided have been discissed. Let use give you one instance—princip the most important one—as determining the right direction of anthropological studies, regarded that the usely of comparative publiclogy would be in lituee the only ask foundation for the study of anthropology. Largustic ethnology was a very favourite term used by Bunnes, Prichard, Latham, and others. It was, in fact, the chief purpose of Banner's paper to show that the whole of manified could be classified according

to language I protested against this view at the time, and in to language I protested against this view at the time, and in 1853; I published my formal protest in a letter to Banaen, "On the Iuranam Languages" In a chapter called "Ethnology sorrus Phosology" I called, if not for a complete divorce, at least for a judicial separation between the study of philodegy and the study of ethnology "Ethnological race," I said, "and phonological race are not commensurate, except in antebistorical times, or, perhaps, at the very dawn of history. With quests and alliances, which, if we may judge from their effects, must have been much more violent in the ethnic than ever in the political periods of history, it is impossible to imagine that race and language should continue to run parallel. The physiologist should pursue his own science, unconcerned about language should pursue his own science, unconcerned about language. Let him see how far the skulls, or the hair, or the colour, or the colour of their words his trace shall be considered to the colour of their words his colour of the colour of their words his colour of their words have been considered to the colour of their words have been considered to the colour of their words have been considered to the colour of their words have been considered to the colour of their words have been colour of their words h His system must not be altered to suit another system. There is a better solution both for his difficulties and for those of the phonologist inhan mutual compromise. The phonologist should collect his evidence, arrange his classes, divide and combine in no Blumenbach had ever looked at skulls, as if no Camper had ever measured facial angles, as if no Owen had ever examined the basis of a cronium. His evidence is the evidence campen of the basis of a cronium. His evidence is the evidence had ever measured takin man. His evidence is the evidence camined the basis of a cranium. His evidence is the evidence of language, and nothing else, this he must follow, even though the control of political. There ought of language, and nothing size, this ne must follow, even though in the teeth of history, physical or political. There ought to be no compromise between ethnological and phonological science. It is only by stating the glaring contradictions between the two that truth cau be elected.

the two that truth can be clusted "a cappace, any, cardonly Al fini my protest met with cappace, any, cardonly Al fini my protest met with cappace, any, cardonly and the cappace and the capp Theorem be ween nation; and tanguages. Into a the book of Daniel, in 4, "the herald cred about. Opeople, nations, and languages." Why then should we not distinguish between nations and languages? But to put an end to every possible misunderstanding, I declared at last that to speak of "an Ayran skull would be as great a monstrosity as to speak of a dolicho-

cephalic language

I do not mean to say that this old heresy, which went by the name of linguistic ethnology, is at present entirely extinct. But among all serious students, whether physiologists or philologists, it is by this time recognized that the divorce between ethnology and philology, granted if only for incom-patibility of temper, has been productive of nothing but good. Instead of attempting to classify mankind as a whole, students

are now engaged in classing skulls, in classing hair, and teeth, and skin Many solid results have been secured by these special researches, but, as yet, no two classifications, based on these characteristics, have been made to run parallel

The most natural classification is, no doubt, that according to the colour of the skin. This gives us a black, a brown, a yellow, a red, and a white race, with several subdivision. This classification has often been despised as unscientific; but it may still turn out far more valuable-than is at present sup-

The next classification is that by the colour of the eyes, as black, brown, bazel, grey, and blue This subject also has attracted much attention of late, and, within certain limits, the results have proved very valuable.

The most favourite classification, however, has always been The most favourite classification, nowever, has always occur
that according to the skulls. The skull, as the shell of the brain,
has by many students been supposed to betray something of
the spiritual essence of man, and who can doubt that the
general features of the skull, if taken in large averages, do correspond to the general features of human character? have only to look round to see men with heads like a cannon-ball and others with heads like a hawk. This distinction has ball and others with heads like a hawk. ball and others with heads like a hawk. This distinction has formed the foundation for a more scientific classification into brachyecphalic, distinctionchalic, and mescophalic skulls. The proportion of 80: 100 between the transverse and longitudinal diameter gives us the ordinary or mesocephalic type, the proportion of 75: 100 the dolichocephalic, the proportion of 85: 100 the brach; cephalic type. The extremes are 70 · 100 and 90 : 100

If we examine any large collection of skulls, we have not If we examine any large collection of skulls, we have not much difficulty in arranging them under these three classes, but if after we have done this, we look at the nationality of each kull, we find the most hopeless consistion. Pruner Bey, as Peschel tells us in his "Volkerkunde," has observed brachy-cephalic and doichocephalic skulls in children born of the same mother , and if we consider how many wo nen have been carried motter , and it we consider how many wo sen have been carried away into captivity by Mongolians in their inroads into China, India, and Germany, we cannot feel surprised if we find some longheads among the roundheads of those Central Asiatic hordes.

hordes.

Only we must not adopt the easy expedient of certain anthropologists who, when they find dolichocephal c and brachycephalic skulls in the same tomb, at once jump to the conclusion that they must have belonged to two different races. When, for instance, two dolichocephalic and three brachycephalic skulls were discovered in the same tomb at Alexandernol. we were told at once that this proved nothing as to the simultaneous occurrence of different skulls in the same family; nay, that it proved the very contiary of what it might seem to prove It was clear, we were assued, that the two dolicho cephalic skulls belonged to Arvan chiefs and the three brachycephalic skulls to their non Arvan slaves, who were killed and ouried with their inasters, according to a custom well known to ferodolus. This sounds very learned, but is it really quite Herodotus

sides the general division of skulls into dolichocephalic. brachycephalic, and mesocephalic, other divisions have been undertaken, according to the height of the skull, and, again, according to the maxillary and the facial angles. This latter division gives us orthognathic, frognithic, and mesognathic skulls

La-tly, according to the peculiar character of the hair, we may distinguish two great divisions, the people with woolly hair (Ulatriches) and people with smooth hair (Lissetriches). The former are subdivided into Tophacom, people with tufts of hair, and Ericcomi, or people with fleecy hair The latter are divided The latter are divided into Euthyroms, straight haired, and Luplocums (not Euploc wavy-haired, as Brinton gives ii), wavy-haired. It has been shown that these peculiarities of the hair depend on the peculiar form of the hnir-tuhes, which, in cross-sections, are found to be either round or elongated in different ways

Now all these classifications, to which several more might be added, those according to the orbits of the eyes, the outlines of the nose, the width of the pelvis, are by themselves extremely useful But few of them only, if any, run strictly parallel It has been said that all dolichocephalic races are prognathic, and have woolly hair. I doubt whether this is true without excep-tion, but, even if it were, it would not allow us to draw any genealogical conclusions from it, because there are certainly many dolichocephalic people who are not woolly haired, as, for instance, the Eskimo, (Brinton's "Races of People," p. 240)

let us consider whether there can he any organic connection between the shape of the skull, the facial angle, the conformation of the hair, of the colour of the skin on one side, and what we call the great families of language on the other. That we speak at all may rightly be called a work of nature, sporn maturale, as Dantes and long ago, but that we speak thas or thus, cost o cost, that, as the same Dante said, depends on our pleasure—that it our work. To imagine, therefore, that as a matter of necessity, or as a matter of fact, doltchocephalic skulls have anything to do with Aiyan, mesocephalic with Semitic, or brachyanything to do with Alyan, mesocephalic with Scientic, or inscrip-cephalic with Turanian speech, is nothing but the wildest random thought, it can convey no rational meaning whatever. We might as well say that all painters are dolichocephalic, and all musicians brach; cephalic, or that all lophocomic imbes work

in gold, and all lissocomic tribes in silver

If anything must be ascribed to prehistoric times, surely the differentiation of the human skull, the human hair, and the differentiation of the human skull, the human hair, and the human skin, would have to be ascribed to that datant period. No one, I believe, has ever maintained that a mesocephalte and a study was spill or differentiated into a diolekoosphale and a Bullet us, for the sake of argument, assume that in prehistore times all dollochechphale people spice Araya, all mesocephale, Semitic, all breinfyerphalic, Turanian languages how would that help us?

So long as we know anything of the ancient Aryan, Semitic-So long as we know anylining of the ancient Aryan, Semitic-and Turanian languages, we find foreign words in cach of them. This proves a very close and historical contact between them for mistance, in Babylonian texts of 3000 u.c., there is the word suddln for cloth made of vegetable fibres, linen That can only be the Sk studdln, the Indus, or saturbara what comes from be the Sk studdin, the Indus, or saturdatase what comes from the Indus I twould be the same word as the Homeric συδώς, fine cloth ("Physical Religion," p 87) In Egyptian we find so many Semaic words that it is difficult to say whether they were borrowed or derived from a common source. I confess I am not convinced, but Egyptologists of high authority assure us that the names of several Aryan peoples, such as the Sicilians and Sardinians, occur in the fourteenth century B C, in the inscriptions of the time of Menculithah I Again, as soon as we know anything of the Turanian languages-Finnish, for instance-we find them full of Arvan words. All this, it may be said, applies to a very recent period in the ancient history of humanity Still, we have no access to endier documents, and humanity Still, we have no access to enrier documents, and we may fairly say that this close contact which existed then

existed, probably, at an earlier time also

If, then, we have no reason to doubt that the ancestors of the people speaking Aryan, Semitic, and Turanini linguages, lived in close proximity, would there not have been marriages between then so long as they lived in peace, and would they not have killed the men and carried off the women in time of war? What, then, would have been the effect of a marriage between a dolichocephalic mother and a brachycephalic father? materials for studying this question of metastage, as the French call it, are too scanty as yet to enable us to speak with confi-But whether the paternal or the insternal type prevailed. or whether their maion gave rise to a new permanent variety, captive woman might be found, after hity or sixty years, spealing the language of the brachycephalic conqueror.

It has been the custom to speak of the early Aryan, Semitic,

and Turanian races as large swarins-as millions pouring from one country into mother. It has been calculated that these early nomads would have required immense tracts of meadow land to keep their flocks, and that it was the search for new pa tures that drove them, by an irresistible force, over the whole inhabitable earth

This may have been so, but it may also have not been so Anyhow, we have a right to suppose that, before there were nullions of human heings, there were at first a few only. We have been told of late that there never was a first man, but we may be allowed to suppo e, at all events, that there were at one time a few first men and a few first women. If, then, the nuxture of blood by marriage and the mixture of language in peace or war took place at that early time, when the world was peopled by some individuals, or by some hundreds, or by some thousands only, think what the necessary result would have been. It has been calculated that it would only require 600 been It has been cutchined that it would only require ooc years to populate the whole earth with the devend units of one couple, the first father being dolichocephalic and the first mother hirechycephalic They mg/th, after a time, all choose to speak an Aryan language, but they could not choose their skulls, but would have to accept them from nature, whether dolichocephalic or brachycephalic

Who, then, would dare at present to lift up a skull and say this skull must have spoken an Aryan language, or lift up a language and say this language must have been spoken by a dolichocephalie skull? \ct. though no serious student would any longer listen to such arguments, it takes a long time before theories that were maintained for a time by serious students, and were then surrendered by them, can be completely eradi cated I shall not touch to-day on the hackneyed question of the "home of the Aryans" except as a warning. There are two quite distinct questions concerning the home of the Aryans.

When students of philology speak of Aryans, they mean by When students of philology speak of Aryans, they mean up Aryan solting but people speaking an Aryan language. They affirm nothing about skulls, skins, hair, and all the rest. Arya with them means speakers of an Aryan language. When, on the contrary, students of physiology speak of dolichocephalic, orthogonable, euthyromic people, they speak of their physiological characteristics only, and affirm nothing whatever about

It is clear, therefore, that the home of the Aryas, in the proper sense of that word, can be determined by linguistic evidence only, while the home of a blue eyed, blond-haired, long skulled, fair-skinned people can be determined by physiological evidence only Any kind of concession or compromise on either side is simply fistal, and has led to nothing but a promisious slaughter of innocests. Separate the two armies, and the whole physicological evidence collected by D'Omalius d'Halloy, Lathaus, and their followers will not fill more than an octato page; while the languistic evidence collected by Bredley and his followers will not amount to more than a few words. Everything else is more day amount to more than a few words.

The physiologust a grateful, no doubt, for any additional skells whose historical antecedents on he firmly established, the philologust is grateful for any additional word that can help to whose historical antecedents on he firmly established, the philologust is grateful for any additional word that can help to the philologust is grateful for any additional word that is possible to argue. They alone have a really scenatife value in the eyes of a scholar, because, if there is any difference of opinion on them, it is possible to come to an agreement. As soon, however, the properties of the properties

My experience during the last forty years have only served to confirm the opinion which I expressed forty years are controlled in the confirm the opinion which I expressed forty years ago, that here ought to be a complete separation between philology and there ought to be a complete separation between philology and the confirmed that the confirmed in the confirmed that th

specific, will be furly welcome to paniologist, quite as much as a tool to the other bearing the property of t

Section In spite of all that I have said against the unholy alliance between physiology and philology, I have felt for years—and I helieve I am now supported in my opinion by all competent anthropologists—that a knowledge of languages must be considered in luture as a una qui non for every authropology.

Anthropology, as yes thou, has necessed or rapidly that it seems to you with "Abda Abs man as an abstrawn jan". So long as anthropology treated only of the anatomy of the human body, any surgeon might have become an excellent anthropologist. But now, when anthropology includes the study of the extract Batta and the seems of the service of the servic

insconnective forms of the mean status and the component interacture. No one would listen to a man describing the peculiarities of the Greek, the Roman, the Jew, the Arab, the Chenese, without knowing their linequages, and being capable often men who have devoted the whole of their life to the study for instance, of Hebrew, differ, not only as to the meaning of certain words and passages, but as to the very character of the Jew, but all Sensitive and passages, but as to the very character of the Jew, but all Sensitive and the study of the study

like all other gods.

You know how widely classical scholars differ on the character of Greeks and Komans, on the meaning of their customs, the control of the classical scholars different to the character of Greeks and Komans, on the meaning of their customs, the their gods. And yet there was a tune, not very long ago, when anthropologists would rely on the descriptions of cassal travellers, who, after spending a few weeks, or even a few years, and even of their regions. It may be said that supplied the people is any Decidedy no, and I am supported in this has yet published his excellent book on the "Mclanesians there Anthropology and Fels-low", spent twenty four years among the Melanesians, learning their dealers, collecting their their characteristics. But what does he say in his preface? "I have felt the truth," he way, "of what Mr Fison, late missionary in that the truth," he way, "of what Mr Fison, late missionary in that the knows all about them, when he has been ten years or samongut them, if he be an observant man, he knows that he

knows very little about them, and so begins to learn."

How few of the books in which we trust with regard to the characteristic poculiarities of savage races have been written by men who have lived among them for ten or twenty years, and who have learnt their languages till they could speak them as well as the nativest themselves.

It is no excuse to say that any traveller who has eyes to see and ears to hear can form a correct estimate of the dougs and saying of savage index. It is not 30, and satisfropologists know and early hear experience of the same throughout the same through the same throughout the same throughout the mage of a young bull. Suppose that the dancer were all stark naded, that after a time they began to fight, and typing about weltering in their blood. Would not a casual traveller have described such awages as worse than the Negroes of Dahomey? Yet these savages were really the Jews, the veller have described such awages as worse than the Negroes of Dahomey? A traveller who contend the measured was Moses We may read the 3nd chapter of Exodus in a very different sense. A traveller who could have sowered with different sense. A traveller who could have sowered with and the same three same

statements of theirs can be used by the antiroprospas tor vary scentific purpose. From the day when this fact was recognized by the highest authorities in anthropology, and was ancicioned by some at least of our Anthropological, Etinological, and Folic-lore Societies, a new specific page, and philology received its right place as the highest day the control of the control of the control proposed our new charter was thus, this it is future no one it to be quoted or relied on as an authority on the customs, traditions, and more

or relied on as an authority on the customs, traditions, and more participating of the religious diese of undervined races who has a religious diese of undervined races who has enable him to converte with them freely on three difficult tablects. No cone would object to this rive when we have to deaf with cyclied and literary nations. But the languages of Africa, and the control of the flowers with the researches of a real Hottentot scholar like Dr. Hahn to When we read the books see the advance that has been made see incagrance that has been made. When we read the books of Bishop Callaway on the Zulu, of William Gill and Edward Tregear on the Polynesians, of Horatio Hale on some of the North American races, we feel at once that we are in safe hands, in the hands of real scholars. Even then we must, of course, remember that their knowledge of the languages cannot compare with that of Bentley, or Hermann, or Burnouf, or Ewald Yet we feel that we cannot go altogether wrong in trusting to their

I venture to go even a step further, and I believe the time will come when no anthropologist will venture to write on any-thing concerning the inner life of man without having himself acquired a knowledge of the language in which that inner life

finds its truest expression

This may seem to be exacting too much, but you have only to look, for instance, at the description given of the customs, the laws, the legends, and the religious convictions of the people of India about a hundred years ago, and before Sanskrit began to be studied, and you will be amazed at the utter caricature that is often given there of the intellectual state of the Brahman compared with what we know of it now from their own literature

And if that is the case with a people like the Indians, who are a civilized race, possessed of an ancient literature, and well within the focus of history for the last two thousand years, what can be expected in the case of really savage races? One can can be expected in the case of really savage races? One can hardly trust one's eyes when one sees the evidence placed before us by men whose good faith cannot be questioned, and who nevertheless contradict each other faily on the most ordinary subjects. We owe to one of our Secretaires, Mr Roth, a most careful collection of all that has been said on the Taumanians by eye-witnesses. Not the least valuable part of this collection of that it opens our eyes to the utter untrustworthiness of the evidence on which the anthropologist has so often had to rely. an article on Mr. Roth's book in NAIURE, I tried to show that there is not one essential feature in the religion of the Tas-manians on which different authorities have not made assertions diametrically opposed to each other. Some say that the Tas-manians have no idea of a Supreme Being, no rites or ceremonies, others call their religion Dualism, a worship of good and evil spirits Some maintain that they had deified the powers of Nature, others that they were Devil-worshippers Some declare their religion to be pure monotheism, combined with belief in the immortality of the soul, the efficacy of prayers and charms. Nay, even the most recent article of faith—the descent of man from some kind of animal—has received a religious sanction among the Tasmanians For Mr Horton, who is not given to joking, tells us that they believed "they were originally formed with talk, and without knee-joints, by a benevolent being, and that another descended from heaven, and, compassionating the sufferers, cut off their tails, and with greass softened their knees?"

I would undertake to show that what applies to the descrip-tions given us of the now extinct race of the Tasmanians applies uong given us or the now extinct race of the tammanneappines of the form to the descriptions of similar all the sawage cance with those to the description of similar all the sawage cance with the contract of the contract o therefore want of sympathy and impossibility of mutual explana-

tion and correction Let me, in conclusion, give you one of the most flagrant instances of how a whole race can be totally misrepresented by men ignorant of their language, and how these misrepresenta-tions are at once removed if travellers acquire a knowledge of the language, and thus have not only eyes to see, but ears to r, tongues to speak, and hearts to feel.

No race has been so cruelly maligned for centuries as the in-habitants of the Andaman Islands. An Arab writer of the ninth

century states that their complexion was frightful, their hair frizzled, their countenance and eyes terrible, their feet very large. and almost a cubit in length, and that they go quite naked.

Marco Polo (about 1285) declared that the inhabitants are no better than wild beasts, and he goes on to say "I assure you all the men of this island of Angamanani have heads like dows. and teeth and eyes likewise, in fact, in the face they are just like big mastiff does."

So long as no one could be found to study their language, there was no appeal from these libels. But when, after the Sepoy mutiny in 1857, it was necessary to find a habitation for a large number of convicts, the Andaman Islands, which had already served as a penal settlement on a smaller scale, became was wrought by this sudden contact between the Andaman Islanders and these civilized Indian convicts was terrible, and population will de out Fortunately one of the English officers (Mr Edward Horace Man) did not shink from the trouble of learning the language spoken by these islanders, and, being a careful observer and perfectly trustworthy, he has given as some accounts of the Andaman aborigines which are real masterpieces of anthropological research If these islanders must be swent of anthropological research 11 these islanders must be swept, away from the face of the earth, they will now, at all events, leave a good name behind them Even their outward appear ance seems to become different in the eyes of a sympathizing observer from what it was to casual traveller. They are, no doubt, a very small race, their average height being 4 feet tof inches But this is almost the only charge brought against them which Mr Man has not been able to rebut their hair. he says, is fine, very closely curled, and friely Their colour is dark, but not absolutely black. Their features possess little of the most marked and coarser peculiarities of the Negro type The projecting laws, the prominent thick lips, the broad and flattened note of the genuine Negro, are so softened down as scarcely to be recognized.

scarcity to De recognized.

But let us hear now what Mr. Man has to tell us about the social, moral, and mellectual qualities of these so called savages, who had been represented to us as canninals, as ignorant of the existence of a destry, as known no marriage, except what by a bold cultimation has been excluded communing and the control of the con

like big mastiffs.

"Before the introduction into the islands of what is called The fore the introduction and the issues of what is caused turpean critication, that of their issues of what is caused turpean critication, that of the interpretation is a consistent leaves of trees. They were ignorant of agriculture, and kept he poultry of domestic animals. Their poticy was hand unde, their clothing very scanty. They were expert swimmers and divers, and able to manufacture well made dug out canoes and outragers. They were ignorant of metals, ignorant, we are told, of producing fire, though they kept a constant supply of burning and smouldering wood. They made use of shells for their tools, had stone hammers and anvils, hows and arrows, harpoons for killing tuitle and fish Such is the fertility of the island that they have abundance and variety of food all the year island that they have abundance and wirely or rood all the year round. Their food was invariably cooked, they drank nothing but water, and they did not smoke. People may call this awaye, the I know many a staving labourer who would gladly exchange the benefits of European civilization for the blessings of such awayery.

blessing of such savagery "
These small islanders, who have always been represented by a certain class of anthropologists as the lowest stratum of humanity, need not fear comparison, so far as their social life is conceined, with races who are called civilized So far from being addicted to what is called by the self-contradictory name of communal marriage, Mr. Man tells us that bigamy, polygamy, polyandry, and divorce are unknown to them, and that the marriage contract, so far from being regarded as a merely temporary contract, to be set aside on account of incompatibility of temper or other such causes, is never dissolved Conjugal fidelity till death is such causes, is never dissolved.

Conjugal nuclify till death is not the exception but the rule, and matrimonal differences, which occur but rarely, are easily settled with or without the intervention of friends. One of the most striking features of their social relations is the marked equality and affection which exist between husband and wife, and the consideration and respect with which women are treated might, with advantage, be emulated by certain classes in our own land. As to cannibalism or infanticide, they are never practised by them. It is easy to say that Mr. Man may be prejudiced in favour of these little savages, whose language he has been also much pains to learn. Fortunately, however, all his statements have lately been confirmed by another authority, Colonel Cadell—the Chief Commissioner of these islands. He is a Victoria Cross man, and not likely to be given to over-much sentimentality. Well, this is what he says of these facer ematifis, with feet a cubit in

length ...

They are merry little people. "It says. "One could not They are merry little people." It says. "One could not them feld in love with them feld in love feld in love with evidence with evidence feld in love feld in lo

delictaces fit for an alderman's table." These are think, which we might suppose anythody who have These are think, which we might suppose anythody who have the suppose anythod the suppose anythod the suppose and suppose and the suppose and suppose and the suppose and s

According to other authorities, some Andamanete look on the tun as tile fountiation of all that is good, the moon as a main power; and they believe in a number of inferior apparts, the spirits of the forest, the water, and the mountain, as agents of the two higher powers. They believe in an evil appit also, who seems to have been originally the ajunt of the storm. Him they try to pacify by songe, or to frighten away with their arrows.

I suppose I need say no more to show how induspensable a study of language is to every student of anthropology. If anthropology is to maintain its high position as a real science, is alliance with languistic studies cannot be too close. Its weakest points have always been those where it trusted to the statements of authorities ignorant of language and of the science of language. Its greatest trumphs have been achieved by men such as Dr. Hahn, Buthops Callaway and Colenno, Dr. W. Gill, and last, not least, Mr. Man, who have combused the minate accuracy of the scholar with the comprehensive grasp of the anthropologist, and were thus mabled to use the key of language to unlock the particularly, of savage religions and mythologist. If this alliance between anthropology and philology becomes real, then, and then only, may we hope to see Busses's prophecy fulfilled, that which has British Associations instituted of the accuracy of the same property of the same proper

Allow me in conclusion once more to quote some prophetic words from the address which Bunsen delivered before our Section in 1847 —

"If man is the apex of the creation, it seems right, on the one sale, that a historical raquery into his origin and development should never be allowed to sever itself from the general body of matural scene, and in particular from physology. But, on the matural scene, and in particular from physology. But, on the which all organic formations tend from the very beginning, if man is at once the mystery and the key of natural scene, if that is the only view of natural scene, worthy of our age, then the only view of natural scene, worthy of our age, then the only view of natural scene, worthy of our age, then the only view of natural scene, worthy of our age, then the only view of natural scene, worthy of our age, then the only view of the order at the physiological are, is the highest branch of that scene for the advancement of which his Association is instituted. It is not an appendix to physiology or to anything else, but it object is, on the contrary, and the contrary of the order of the physiology of the contrary of the order of the

actions of a scientific Association. "Much has been achieved by anthropology to justify these hopes and failfil the prophecies of my old frend Bunsen. Few men live to see the fullificant of their own prophecies, but they leave disciples whose duty it is to keep their memory alive, and thus to preserve that vital continuity of human knowledge which alone enables us to see in the advancement of all science the historical evolution of eternal turns of the properties."

LLECTRICAL STANDARDS

THE Queen's Printers are now issuing the Report dated by 23, 1891 to the President of the Board of Trade, of the Committee appointed to consider the gestion of construcing standards for the measurement of electricity. The Committee included Mr Courtenay Boyle, C.B., Major P. Cardew, R.E., Mr. E. Graves, Mr. W. H. Preece, F.R.S., Sir W. Fhomson, F.R.S., Lord Agyligh, F.R.S., Frof G. Care, Foster, F.R.S., Mr. R. 1. Glasebrook, F.R.S., Dr. John Hopkinson, F.R.S., Pof W.F. Ayton, F.R.S.

In response to an invitation, the following gentlemen attended and gave evidence —On behalf of the Association of Chambers of Commerce, Mr Thomas Parker and Mr High Erst Harmon, no behalf of the Association of the High Erst Harmon, or behalf of the of the London Chamber of Commerce, Mr R. E. Crompton The Committee were indebted to Dr. J. A. Fleming and Dr. A. Murrhead for valuable information and assistance, and they state that they had the advantate that the Committee was start of the Advantate Superintendent of Weights and Measures. The Screenary to the Committee was bir T. W. P. Blomefield,

The following are the resolutions of the Committee :-

Resolutions.

(1) That it is desirable that new denominations of standards for the measurement of electricity should be made and approved by the Marshum of Council as Royal of Toule and the provided in the council of the council o

by Her Majesty in Council as Board of Trade standards.

(2) That the magnitudes of these standards should be determined on the electro magnetic system of measurement with reference to the centimetre as unit of largib, the gramme as unit of mass, and the second as unit of times, and that by the terms centimetre and gramme are meant the standards of those denominations deposited with the Board of Trade.

(3) That the standard of electrical resistance should be denominated the ohm, and should have the value 1,000,000,000 in terms of the centimetre and second.

(4) That the resistance offered to an unvarying electric current

by a column of mercury of a constant cross sectional area of a square millimetre, and of a length of 106'3 centimetres at the temperature of melting see may be adopted as 1 ohm.

(5) That the value of the standard of resistance constructed

(5) That the value of the standard of resustance constructed by a committee of the British Association for the Advancement of Sedence in the years 163 and 1864, and known as the British Association man, may be taken as 1986 of the obm (6) That a maternal standard, countracted in solid metal, and the standard obm.
(7) That for the purpose of replacing the standard, if lost, destroyed, or damaged, and for ordurary use, a huntel number of copies should be constructed, which should be periodically compared with the standard obm.

(8) That resistances constructed in solid metal should be adopted as Board of Trade standards for multiples and submultiples of the ohm.

(9) That the standard of electrical current should be denominated the ampere, and should have the value one tenth

(0) That an unvarying current which, when passed through a solution of nitrate of silver in water, in accordance with the specification attached to this report, deposits silver at the rate of o'cottis of a gramme per second, may be taken as a current of

(11) That an alternating current of I ampere shall mean a current such that the square root of the time average of the square of its strength at each instant in amperes is unity

or its strength at each instant in ampere is inity (12) That instruments constructed on the principle of the balance, in which by the proper disposition of the conductors, forces of attraction and repailson are produced, which depend upon the amount of current passing, and are balanced by knowledges, should be adopted as the Board of Trade standards for

weights, should be adopted as the Board of a rade standards for the measurement of current, whether unwarying or alternating (13) That the standard of electrical pressure should be de-nominated the volt, being the pressure which, if steadily applied to a conductor whose resistance is 1 ohm, will produce a current

(14) That the electrical pressure at a temperature of 62° F between the poles or electrodes of the voltage cell known as between the poles or electrodes of the voltace cell known as Clark's cell, may be taken as not differing from a pressure of 1 433 volts, by more than an amount which will be determined by a sub-committee appointed to investigate the question, who will prepare a specification for the construction and use of the cell (15) That an alternating pressure of 1 volt shall mean a pressure such that the square root of the time average of the square

sure such that the square root of the time average of the square of its value at each instant in volts to unit,

"The first invariants constructed on the propelle of Sir VIII.

"The structure of the structure o ment of pressure, whether unvarying or siternating

We have adopted the system of electrical units originally fined by the British Association for the Advancement of defined by the Science, and we have found in its recent researches, as well as in the deliberations of the International Congress on Electrical Units, held in Paris, valuable guidance for determining the exact magnitudes of the several units of electrical measurement, as well as for the verification of the material standards.

We have stated the relation between the proposed standard ohm and the unit of resistance originally determined by the British Association, and have also stated its relation to the mercurial standard adopted by the International Conference

We find that considerations of practical importance make it undesirable to adopt a mercurial standard, we have, therefore, preferred to adopt a material standard constructed in solid metal.

It appears to us to be necessary that in transactions beat appears to us to be necessary that in transactions between buyer and seller, a legal character should henceforth be assigned to the units of electrical measurement now suggested, and with this view, that the issue of an Order in Council should be recommended, under the Weights and Measures Act, in the form annexed to this report.

Specification referred to in Resolution 10.

In the following specification the term silver voltameter means the arrangement of apparatus by means of which an electric NO. 1140, VOL. 44

current is passed through a colution of nitrate of silver in water. The silver voltameter measures the total electrical quantity which An entirer voltameter measures the total electrical quantity which has passed during the time of the experiment, and by noting this time the time-average of the current, or if the current has been kept constant, the current useff, can be deduced in employing the silver voltameter to measure currents of

about 1 ampere, the following arrangements should be adopted.

The kathode on which the silver is to be denosited should take and a platinum bowl not less than 10 cm in diameter, and from 4 to 5 cm in depth

The anode should be a plate of pure silver some 30 square cm.

in area and 2 or 3 millimetres in thickness

in area and 2 or 3 millimetres in thickness.

This is supported horizontally in the liquid near the top of the solution by a platinum wire passed through holes in the plate at opposite comers. To prevent the dismitgrated ulver which is formed on the anode from falling on to the kathode, the anode should be wrapped round with pure filter paper, secured at the back with sealing wax.

The liquid should consist of a neutral solution of pure silver

nitrate, containing about 15 parts by weight of the nitrate to 85 parts of water

The resistance of the voltameter changes somewhat as the current passes. To prevent these changes having too great an effect on the current, some resistance besides that of the voltameter should be inserted in the circuit. The total metallic resistance of the circuit should not be less than 10 ohms

resistance of the circuit shown not be text than at some Method of making a Measurement—The platinum bowl is washed with nitite acid and distilled water, dred by heat, and then left to cool in a desiccator. When thoroughly dry, it is

then left to cool in a desictator when inortuginy dry, it is weighted carefully

It is nearly filled with the solution, and connected to the rest of the circuit by being placed on a clean copper support must be which a binding screw is attached. This copper support must be insulated

The anode is then immer ed in the solution, so as to be well covered by it, and supported in that position, the connections to the rest of the circuit are made

Contact is made at the key, noting the time of contact current is allowed to pass for not less than half an hour, and the time at which contact is broken is observed. Care must be taken that the clock used is keeping correct time during this interval

The solution is now removed from the lowl, and the deposit is washed with distilled water and left to soak for at least six hours. It is then rinsed successively with distilled water and hours It is then rinsed successively with distilled water and alsolute alcohol, and drade in a hois-in table at a temperature of ahout 160°C. After cooling in a desiccator, it is weighed again. The gain in weight gives the silver deposited. To find the current in amperes, this weight, expressed in grammer, must be divided by the number of seconds during

which the current has been passed, and by 0 001118

The result will be the time-average of the current, if during the interval the current has vaned.

In determining by this method the constant of an instrument the current should be kept as nearly constant as possible, and the readings of the instrument taken at frequent observed inter vals of time. These observations give a curve from which the reading corresponding to the mean current (time average of the current) can be found. The current, as calculated by the voltameter, corresponds to this reading

NOTES

THE International Meteorological Conference at Munich was o, ened on August 26. Dr C Lang, Director of the Bavarian Meteorological Service, was unanimously elected President Prof M. W. Harrington (Chief of the United States Weather Bareau) and Prof E Mascart (Director of the French Meteoralogical Service) were elected Vice Presidents Mr R II Scott (Secretary of the Meteorological Office), Dr F Erk (Munich), and M L Tesserenc de Bort (Paris) were elected Secretaries. Thirty members were present, including representatives from Brazil, Oueensiand, and the United States We hope in a future number to give some account of the proceedings

DR BARCLAY, whose death at Simla has been announced, was working on the Leprosy Commission, and his loss is

described by the Indian press as not only a severe one to Indea, but for the whole scintillic world. His special study was exprogramic borary. He made important researches in dnesses of Indian pitants, and its guared a continuousla repulation. Several of he papers were published in the Linnean Society's Transactions. His great ambition was to solve Indian wheat disease, and he was to have studied coffee disease no Southern Indian next water.

PARTLY owing to Dr. Barclay's death, the Indian Leprose Report will be delayed as hort time. The practical work is virtually completed, and the Draft Report for the Government of India is in type. The chief work now consists in correcting the proofs and the preparation of the plates, maps, and statistics. On the two mansi questions with which they were to deal, vir. the contagousness and hereditary transmission of the dienses, the Commission have come to a manitomiss decision, but their conclusions will not be known till the Report as published by the National Leptone Fig.

THE statutory mith meeting of the International Congress of Orientalists began in the hall of the Inner Temple on Tuesday, when an address was delivered by the Master of St. John's College, Cambridge,

An election to the Coutts Trotter Studentship, at Trinity College, Cambridge, will take place next month. Applieations from candidates must be sent in to the College folice, addressed to the Secretary of the Coutts Trotter Studentship Committee, on or before October 15. The studentship is tenable for two years, and its for enginal research in physiology or in physics.

We are glad to learn that a number of the friends of the late Mr N R Pogeon are thinking of raising a memorial to him in Madris

WITH reference to a recent note, we learn from New South Wales that the Minister for Mines and Agriculture (the Hon. Sydney Smith) has appointed Mr. Niel Harper, formerly a dairy farmer of excellent repute in the South Coast District, to take charge of the travelling dairy, which is to be sent to the different districts of the colony under the control of the Department of Agriculture. It will be necessary for the Agricultural Society, or a local Committee, to provide the requirements of the dairy such as a building suitable for its operations, and giving accommodation sufficient for ten pupils, who will be thoroughly instructed in all dairying operations. Also, for the carriage of the plant to and from the nearest railway station or wharf to the scene of operations, together with the necessary labour to assist in the rough work of cleaning up, &c. The Society, or Committee, will need to provide also a sufficient supply of milk, say about fifty gallons daily, for the operations of the dairy, and plenty of clean water for washing butter and cleaning up. Each Society, or Committee, undertaking to furnish these requirements will be entitled to nominate at least ten pupils (either male or female) for the full course of instruction in dairy operations, who will afterwards be examined with a view to receiving a dairy certificate in the event of their showing a satisfactory knowledge of the course of instruction Of course the general public will be admitted to see all the operations of the dairy, which will work for ten days at each place where set up. All district Societies and Committees desiring to have the benefit of this course of instruction for their localities should make early application to the Director of Agriculture, from whom regulations and instructions can be obtained. Is our Minister of Agriculture doing anything similar?

At the request of the Russian Ambassador in London, the Secretary of State for India has asked the Government of India to afford facilities to Prof. Tichomiroff, who is about to visit

certain parts of India, Ceylon, and China, with the view of studying the administration of botanical gardens and cinchona plantations, and to M. Gondatti, who is about to study tea and silkworm cultivation in India, Ceylon, and China

CAPTAIN WAHAB, R E, will have charge of a party which is to make a survey of the country round Aden during the coming winter.

MR. GRIESBACH, of the Geological Survey of India, has proceeded with a survey party to Upper Burmah, where he will remain about two years to examine thoroughly the geological condition of the country.

AN important resolution of the Government of India on the reorganisation of the superior staff of the Indian Forest Department has been sissed. At an extra yearly cost of three lakeh or injurye, the Importal and Promoral Services are to be separated. The Importal is to be recruited solely indice revenant with the Section of Siste, and the average pay raised 6 per cent. The Promincal Service gives 155 appointments, up to 600 rispects a month, to natives of India. The Forest Department is the first to introduce a complete scheme under the Public Service Com-

NINE members of the Aitt Arctic Expedition arrived at Haliata, N S, on August 30. The Expedition reached 77 43 'N, and 70 20' W They have brought with them immense collections of flowers, herin, and butterflees, some of which were previously unknown. It is stated that "they found all the published charts of Greenland to be incorrect."

Expansions for the production of artificial rain are now being made in Texas. They are conducted by menthers of the Nignal Copp, acting under the direction of the Minister of Agriculture, and have been undertaken in accordance with a vote of the United State's Congress. Alequate: reports on the subject have not yet reached that country, but it is claimed that the experiments have been attended by remarkable success.

Ms GYOKOE FORBER, writing to the Times on August 31, gave the following account of a meteor which he had seen at Madenhead on the previous evening at 8h. 32m.—"It was madenhead on the previous evening at 8h. 32m.—"It was the properties that 15 miles and 11 miles that of three seconds from the time. I first saw it, it steadly increasing in its rear part when at its triphter—re just before extinction. There was no train, the luminosity not extending more than the state of the state o

In the Meteorologische Zeitschrift for July, Prof H. Mohn discusses the present methods of reduction of meteorological observations: after the completion of twenty-five years of observations at the Nors egian stations, he has decided upon making certain more or less important alterations, commencing from January I last (1) As regards pressure, to introduce the correction for standard gravity at sea-level, in latitude 45°, which amounts to 0'16 inch between the equator and the Poles, and to as much as 0 03 inch between two extreme stations of the Norwegian system And to apply a correction due to diurnal range (to be determined from bourly observations) to the monthly means obtained and published from two or three observations daily. (2) Similarly, for temperature and humidity, to apply corrections to the published monthly values obtained from two or three daily observations. He fully explains the methods he has adopted for obtaining the corrections to be applied, and we thin't the matter is worthy of the attention of meteorologists who publish their results Prof. W. von Benold gives an interesting summary of his paper on the theory of cyclones, which he laid before the Berlin Aendemy in December last, and in which he treated of the more recent views regarding the laws of atmospheric circulation, he also refers to various points which have to be dealt with for the further advancement of the scene.

M. LAKEASTER has recently indicated in Cut of Test of the divergences from normal temperature in Largo in the five years 1856-500. It appears (and as shown in a map) that the scatter of the "shaind of cold" like so over the north of France, the world of Belgium, and the most seatern parts of Germany. From this centre is the cold decreases pretty regularly counseled as all selects to keed decreases pretty regularly counseled as all selects as a nearly created the of the divergence, which can be suffered to the selection of the s

SR H MORIZE, astronomer at the Observatory of Rio de Isneiro, has just published a "Sketch of the Climatology of Brazil," which will be welcome to meteorologists, as hitherto systematic observations have only been published for a very few points of that immense country, covering 30° of latitude. The present sketch has been drawn up mainly from the observations of travellers and private observers. We can only extract a few brief notes Thunderstorms are very frequent all along the coast, and are mostly harmless, regular cyclones are very rare-the most dangerous winds are the pamperos, which blow from the south-west, and have been fully described by the late Admiral Fitz-Roy, and a still more rare and dangerous wind which blows from the south east. As regards temperature, the author has divided the country into three zones, and some valuable data are given for various localities. Parts of the country are subject to prolonged drought, it is said that at Pernambuco no rain fell during the whole year 1702, and a third of the population died fron its effects; droughts have recurred during the present century with some regularity, the last being in the year 1888-89 The most complete series of observations is that for Rio de Janeiro, which dates from 1781, with occasional interruptions The highest shade temperature was 99"5 in November 1883, and the lowest 50° 4 in September 1882 There are also good series of observations for Rio Grande do Sul and São Paulo

ONE of the most important contributions made of late years to our knowledge of the embryology of flowering plants is to be found in a paper by a lady, Mdlle, C. Sokolowa, in the Bulletin of the Imperial Society of Naturalists of Moscow. It relates especially to the formation of the endosperm within the embryo sae of Gymnosperms, the particulars of which are described in great detail. The process is somewhat intermediate between that of ordinary cell-division and that known as free cell-forma tion. It is a group of short cells belonging to the parietal layer of this endosperm that ultimately develop into the corpuscles or secondary embryo sacs, the homologues of the archegones of Vascular Cryptogams. In the tendency displayed by Pinus and Cephalotaxus towards the early differentiation of these cells. Mdlle. Sokolowa sees the foreshadowing of the process which is universal in Angiosperms, the formation of the embryonic v.sicles before that of the endosperm Ephedra exhibits a still closer approximation in this respect to Angiosperms than to the Conifers. In the same number of the Bulletin is an interesting and important paper by Prof. Goroschankin on the "Structure and Reproduction of Chlamydomonas." The former paper is written in French, the latter in German.

NO. 1140, VOL. 44]

The surery of the cañon of the Colorado, has now been completed, and Mr. R. B. Station has given a fall account of it in the American Engineering New In spite of the great depths of the cañon and the clifts of anadotione, marble, and granite compoung it, a railway can in his opinion be built through it without much tunnelling, thus opening up some of the grandest seenery of the world. In many places the cañon expands into wide valleys, and even where it in rows there are terraces along the sides like the "parallel roads" of Given Roy in Sextland, which seem designed by nature, for track and rail. The tributaries which entire the cañon laterally are as a rule small, and can be easily bridged. The distance of 1019 miles through the cañon district will only comprise 20 miles of tunnelling and 99 miles of grantee cutting.

At the meeting of the Linnean Society of New South Wales, on June 24, Mr. C Darley shibited some very large examples of the shells of the mud syster (Ostriva shifts), war, angan) obtained during dredging operations in Rocale Bay, Sydiney Harbour, They occur in great numbers at a digth of to 1a feet below low water mark beneath a layer of black mud 3 to 4 feet back, and are much larger than specimen now to be found living in the harbour. The two valvas of one pair weigh 3 pounds 1 a ounces, and measure about 8 & 6 inches;

IN Nature Notes for August Mr. R T. Lewis, on the authority of a correspondent in whose trustworthiness he has entire confidence, gives a curlous account of the appreciation with which the song of the Cicada is heard by insects other than those of its own genus. The correspondent has frequently observed in Natal that when the Cicada is singing at its loudest, in the hottest portion of the day, it is attended by a number of other insects with lovely, gauze-like, iridescent wings, whose demeanour has left no doubt on his mind that the music is the attraction The Cicada, when singing, usually stations itself upon the trunk of a tree with its head uppermost, and the insects in question, to the number sometimes of fifteen or sixteen form themselves into a rough semicircle at a short distance around its head. During a performance one of the insects was observed occasionally to approach the Cicada and to touch it upon its front leg or antennæ, which proceeding was resented by a vigorous stroke of the foot by the Cicada, without, however, any cessation of its song The insects composing the audience are extremely active, and so wary that they take flight at the least alarm on the too near approach of any intruder. Some of them, however, have been captured, and on examination these " proved to belong to the same family as that most beautiful of British insects-the lace-wing fly, which, indeed, they closely resemble except as to size, their measurement across the expanded wings being a little over two inches, they have since been identified by Mr. Kirby at the British Museum as Nothochrysa gigantea.

ACCORDING to a telegram through Dalucal's agency from Accountry, the Canadana Facolic sensent "Open," which arrived therefrom Hong Kong and Vokohama on August 30, has reported a termife typhone ast Kodo on the fish that All the steamers in the harbour dragged their anchors, and many native boats were cast abstroad their cives were drowned. A Gertana stemaship was driven subnor and eight of the crew were drowned, and an Indiana burque. Surgleir as werecked, and all no hoard arong natives and foreigness it as believed that a 50 lives were lost. Her Majesty's gusboat Thord sank. Altogether among natives and foreigness it as believed that a 50 lives were lost. The wind did much danange imbore. In one coast town forty-five penagoa were killed by falling houses.

THE Science and Art Department has issued its Directory (revised to June 1891), with regulations for establishing and conducting science and art schools and classes.

This University College, Bratol, has issued its Calendar for the session 1891-92. While the College supplies for persons of either see above the ordinary school age the means of continuing, their studies in science, languages, history, and literature, it claims especially to afford appropriate and systematic instruction in those branches of applied science which are more nearly connected with the arts and manufactures.

Six WILLIAM MAGGREGOR, Governor of British New Counce, recently scended Mount Vale, or Kowo, as he prefers to call ut. The Kowo range is volcante and isolated from the man chain, of which Mount. Owen Stanley is the cellmantion. The Kowo range is under 1,000 feet high, and it wooded to the very summit. Native tracks lead through the forest to the top of Mount Vulle, on the south-west front of which there is a magnificent series of cassades, having a height of good feet in all. A new river and in new lake were also discovered, but the animal tile of the region was far from shoundard.

The last Bulletin of the Geographical Society of the United Datas contains an interesting puper on the curvos alsowers of human remains under the Tuolsame Table Mountain of Cahernia Bones of mea and granding instruments were there found by Prof. Whitney, embedded in surficeose gravel under law at the foot of the mountain. Re names of plants belonging to the Tertiary age, and the bones of extinct Mammalia, such as the rhinocrose of the West and the American survivolon, are also met with in the same strata. Featles, morters, and broken pear heads are the most remarkable of the implements disposed the data of the most remarkable of the implements dis-

From the last Report of the Council of the North China Annite Sectify OShanghas we learn that the printers have now in hand a most valuable work by Dr. Breichneider on the Botany of the Chinese Claisse, "the public atom of which, on account of its length and technical difficulties, has been much closed as the council of the length and technical difficulties, has been much closed. Mr. Faber has undertaken the difficult insk of correcting the printer's proofs and adding many notes, which will reader the work the most comprehensive and useful book which hay tel appeared on Chinnese boats on China School and the system of the contract of the council of the contract of the council of the coun

THE new number of the Internationales Aschio Jur Ethnographs, (Band w, Heft 4) opens with an interesting paper by Prof. A. C. Haddon, on the Tugern head hunters of New Guinea Mr J J. M. de Groot has an article on the wedding garments of a Chinese woman, and Dr Julius Jacobs discusses (in Dutch) the closes of Dr Ploss on the ongoin of erreamenton.

MESSEN WEST, NEWBAN, AND CO, have reprinted from the Journal of Relating for 1891, a "Key to the Genera and Species of British Mosses," by the Rev II G Jameson. The author explains that his work is not intended to take the place of a more delatile text book, but interely to serve as a clae by which the student may ascertain as what part of his book he shald look for the description of any unknown specimen.

Wa have received a Report on Astronomical Observations for 1886, by George H Boehmer Directors of observatories, and astronomics generally, are earnestly requested by Mr. Boehmer to criticize his work freely, and to send him such corrections and additions as may seem to them necessary or destrable

MESSES W. WESLEY AND SON have published a catalogue of botanical books which they are offering for sole.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (Macacus synomolgus ?) from India, a Pinche Monkey (Midas unipus d) from New Granada, presented by Mr. H. Wather; a Roseate Cockatoo.

Constitute restocation from Australia, presented by Mrs. Aug. Dones, F.E. S., a Slander-Dulled Cockasion Citamotic resultivistration of the Cockasion Citamotic resultivistration of the Cockasion Citamotic resultivistration of the Cockasion Cockas

OUR ASTRONOMICAL COLUMN.

STARS HAVING PECULIA. SPECIER.—From a communication by Prof. E. C. Prickering to Autonomical Naturchiaka, No. 3954, at appears, that the hydrogen lines G and a are triple in a photograph of the spectrum of a thrivingue sar, D M + 39 485 (R A, 22h 34 7m, Decl + 39 485 (8 A) 400. D M + 39 485 (R A) 42h 44 7m, Decl + 39 485 (R A) 400. D M + 39 485 (R A) 400. D M + 30 485 (R A) 400. D M + 3

se mane out in the wisole spectrum or to ear.

Plaction-APPA or SOLAR Plantic several, all the metaPlaction-APPA or SOLAR Plantic several, all the
ladders exhibited some of the results he has obtained since Migladders exhibited some of the results he has obtained since Migladders exhibited some of the results he has obtained since Migladders and the photography of bright lines are solar promisence spectra.

The regatives exhibit good reversals of Ha and K, and the first two
lines of the ulim-voide hydrogen series. Art M. Desinadres
bright line a hitle less refinegible than H is really due to
hydrogen. It is proposed to construct an apparatus by means
of which the promisences at all points on the sun't limb may
observers. Prof. Hale and M. Delandres, hould have been
smultaneously working to attain the same object is somewhat
mercantalla. From he vanous paper gublished by the former
remarkable. From he vanous paper gublished by the former
remarkable. From he vanous paper gublished by the former
and K in prominence spectra about the middle of April, as of the
first photograph showing the form of a promisence on May 7.

ENCKE'S CONFT (c 1891) —The following ephemens is from one given by Dr. Backlund in the Bulletin Astionomyne for August —

189	٠.			R A				Decl			Log r.		Log a.
Aug	28		h S	''12	29		+35	8	ő		0 0563		0 0454
Sept	1		6	31	22		35	9	5		0.0316		0 0220
**	5		7	2	24		34	43	5		0 0045		0 0025
**	9		7	35	36		33	40	ğ		9'9749		9 9850
**	13			10			31	58	4		9'9424		9'9719
**	17		8		49		29	29	7		9 9060		9 9638
**	21		9		59		26		9		9 8655		9 9626
**	25			55	0		22	25	7		9 8200		9 9677
_,,,	29			27			18	4	7		9.7689		9 9727
Oct	3				18		13		6	•••	9'7120		9 9983
**	7			27			8		2		9 6503		0 0223
**	11		п	57	2		+ 3	23	2		9 5897		0.0108
**	15		12	26	30		- 1	44	4		9'5744		0'0781
**	19			56			6	46	í		9 5 136		0.1020
**	23			27	41		11		3		9.5634		0'1278
**	27				6		15		8		9 6187		0'1472
**	31		14	27	27		~ 18	49	3		9 6809		0'1646
Th	e co	met	LS	no	w in	Au	riga, v	whic	h is	ın tl	e north-	ORE	t about

10 p m. On September 8 it passes about 2° north of Castor.

A New Astracot (40).—On August 12, Dr. Palisa observed
what may be a new asteroid, or, according to Dr. Berberich, it
may turn out to be identica' with (40) or (50).

NO. 1140, VOL. 447

7UPITER AND HIS MARKINGS

DURING the last few years, Jupiter has been suitated so far south of the equistor that telescope observations have had to be pursued under all the disadvantages maeparable from viewing an object at a low sittined. But the conditions are now much improved, the planet, though still in assub declination of the contraction of the contract

resumed under very encouraging circumstances. The great red spot has been visible and its appearance and movements closely watched during thritten parts, for it was in 1914 1875 that it was first amounted as a striking object. But July 1875 that it was first amounted as a striking object. But July 1875 that it was first amounted as a striking object. But observes include forms which has not proposed to the control of the c

After a tomewhat precurous existence, the spot appears to be recovering prominence, shough its present aspect will not bear compartion with the features it presented about twelve years with the features it presented about twelve years with the present present present present the present to have required the reddish bee, and the general appearance of the object is sufficiently marked to recall the grand were at afforded at the period of its most. The variable motion of the spot has formed one of its most

The variable motion of the spot has formed one of its most interesting attributes, and I give below a table of the mean rotation period deduced from observations during the last eleven oppositions of Jupiter —

Limiting dates				Rotations			Period		
	-					h	m		
1879 July	10-1880 Feb	7		512	•••	9	55	34 2	
1880 Sep.	27-1881 Mar.	17		413		9	55	35 0	
	8-1882 Mar	30		640		ò	55	38 :	
	29-1883 May	4		674		9	55	39 1	
1883 Aug	23-1884 June	12		710		9	55	39 1	
1884 Sep.	21-1885 July	8		700		9	55	39 3	
1885 Oct	24-1886 July	24		659		9	55	41	
	23-t887 Aug.			609		9	55	40	
	12-1888 Aug			462		9	55	40 3	
	28-1889 Nov			439		9	55	40 0	
1800 May	22-1800 Nov	25		451		ò	55	40"	

On August 7, 1891, I re observed the spot with a 10 inchedency power zgis, and found it will defined and fairly conspicuous. It passed the central meridam of the planet at 11h, 2ms, so that it followed Marth's zero mendiam (System Lions by Mr. A. S. Williams in May last, which placed the top of a minute behand the zero mendiam. Mr Marth's compatations are to be found in the Monthly Notices for March Debetonets.

Agast from the red spot, it is desirable that the white spots nor the planet's equator, and the smaller markings which verge the northern sade of the north equatorial belt, should be assoliated the same of the spot of the same spot of the same

variation apparently affects the course equational zone, and it will be important to dete mine the exact extent of it, and whether it is asstained in the present year. The thinges of velocity alluded to are exercely progressive in the same direction, we may expect to find an acceleration sooner or later to compensate for the relatively slow movement of the spots in the few past years It is not unlikely that the various marking.

compensate for the relatively slow movement of the spots in the few past years. It is not unlikely that the various markings show oscillations of speed recurring at uniform intervals. Students of this interesting plante will find abundance of materials to collate and discuss. There is ample evidence of materials to collate and discuss. There is ample evidence of the student of the speed of the student of the student plant plant plant plant planted that the speed of the more durable markings appearingly suffer temporary obscuration by vaporous masses suspended above them in the Jowass atmosphere. In the disposition of the belts is also liable to changes, though not so rapadly as is generally supposed, for many of the altigued variations have been due to differences in telescopic definition or to tapid totation of the disposition of the student of the disposition of the student of

SCIENTIFIC SERIALS

American Found of Science, Aurust - Some of the American Journal of Science, August — Joine of the features of non volcanic igneous ejections, as illustrated in the four "Rocks" of the New Haven region, West Rick, Pine Rock, Mile Rock, and East Rock, by James D. Dana. A few of the conclusions arrived at from the observations recorded in this paper are that igneous cruptions occurred in the New Haven region after the sandstone had been noturned. The hund rock forced its way between layers of the sandstone, and lifted it up where the pressure of the rock was not too great to prevent the upheaval. This intrusive action was favoured by the fact the upheaval. This intrusive action was favoured by the fact that the fissure supplying the lava was inclined in the same direction as the layers of the uplifted sandstone. And the logi-tion of the underlying scluss did not determine the course and dip of the upply fissures. The paper is illustrated by several excellent photographs of the formations investigated— Note on a reconnaissance of the Quachita mountain system in Indian territory, by Robert T Hill.—The continuity of solid and liquid, by Cail Barus By means of the simple airangement described in this paper, the author is able to obtain at once the isothermals and isomestics, and therefore the mometries, both for the solid and liquid states of the substances experimented The relation of solidification and fusion to pressure and the pressure changes of the isothermal specific volumes of solid the pressure changes or the isomerous specine volumes of solution and liquid at the solutioning and melting points can all o'be determined. And from such results the character of fusion and the probable position of critical and transitional points can be found. The author has as yet only investigated the biliavour of naphitaliene by his method, but the whole work, throws considerable light upon the relation of pressure to phenomena of saterable light upon the relation of pressure to pnenomena of fusion and solution—Note on the appliation of Utah and Colorado, by George H Stone. The author has visited all the known asphalte fields of Western Colorado and North Eastern Utah. The observations he has made bear upon the origin of Dain Inconstructions ne has made occur upon the origin or petroleum, asphalte, natural gas, and other subterranean hydrocarbons, but the faces are hardly sufficient to lead to definite conclusions.—Photographic invistigation of prominences and their spectra, by George E Hale. Account is given of the methods employed by the suther for the photography of invisible solar prominences. Special attention has been directed to the photography of the bright prominence lines running through H and K, with a slit tangential to the sun's limb Four reproductions of negatives showing prominences illustrate the paper -A gold bearing hot spring deposit, by Walter Harvey Weed A microscopical and cliemical examination of some spicimens of ore from the Mount Morgan Gold Mine, Queensland, demonstrate of the Mount Morgan Gold Mine, demonstrate of the Mount Morgan G strates that the mine is a deposit of a hot spring, the ore being a siliceous sinter impregnated with anriferous hiematite. This a success since impregnated with an interest factories that is the only hot spring depost that has been found to contain gold in commercially valuable quantities, and although the sinter deposits from the hot springs of Yellowstone Park resemble those from Mount Morgan, no trace of the precous metals has been found in them -Res ciation of Stegosaurus, by O. C. Marsh. The species restored is Stegmann stingularin, from the Upper Jarassic of Wyoming A plate, representing the reptile one thirtieth its natural size, accompanies the paper.

THE American Meteor-logical Journal for July contains the following articles:—Franklin's kite experiment, by A. McAdie After groups whose details repreding Franklin's experiments, After groups whose details repreding Pranklin's experiments, the Billac Hill Observatory, new Roston, U. S., the chief Advance being that a every skep the electronel potential of the atmosphere was measured by an electrometer. The kite was sent up to accept the service of water from the electrometer during electrical disturbance of water from the electrometer during electrical disturbance of water from the electrometer during electrical disturbance always foreign when a final fighting was about to occur — Cloud height and the state of the control of the con 6500 m, circo stiatus 9652 m, circus 10,135 m. The The Upsale observations show that the base of the cumulas, is well as the cirrus, uncrease in height and evening, but neither of these conditions and by to the observations at blue till. I got an experience of the condition of the condition of the condition found to be 133 miles and hour. A comparison between wind and cloud velocity shows that below 500 metres, the wind of the cloud to the condition of the condition of the condition of the cloud to the condition of the condition of the condition of the decreases again velocity increases up to 1000 metres, and then decreases again velocity increases up to 1000 metres, and when the probability due to the fact that the double between 700 and 1000 probability due to the fact that the double between 700 and 1000 The Upsala observations show that the base of the cumulus, as probably due to the fact that the clouds between 700 and 1000 metres were movely observed during the morning, when the said 1700 metres were movely observed during the addition, when the cumulants moves allowest. Meteroological kills flying, by W. A. Eddy This is an account of some experiments made of which the contraction of the contraction of warm and current by means of Self-recording thermometers carried by a kill extract. Experiments showed that an altitude of 1800 feet contract the contraction of the offset contraction that many of 1800 feet could be obtained by using one kite, and that many hundied feet could be added to the altitude by hing the weight of slack string by fastening on larger kites. It is estimated that by this means an altitude of 4000 feet was obtained. The minimum temperature at an altitude of about 1500 feet, on February 14 last, was only 2' lower than at the surface

SOCIETIES AND ACADEMIES.

Academy of Sciences, August 24 -M. Ducharire in the Academy of Sciences, August 24—M. Discharre in the chair—Remarks on the dynamic conditions of the development of conctary tails, by Dom Et Stiffert—Résumé of solar observations made at the Observatory of the Roman College during the second quarter of 1891, by M lacchim—On cyclic systems, by A Ribaucour —A property of involution, common to a group of five right lines and a system of nine planes, by M. P. Serret. -On the tension of water-vapour up to 200 atmospheres, by M. Ch Antoine From the expression t = 1638 - 0.0005Pdeduced from the experimental results of MM. Calletet and Colardeau, the author deduces formulæ for the calculation of P to a first approximation, by the aid of the general formula $P = G\left(\frac{T-\lambda}{T}\right)^{\alpha}$, given by J. Bertrand to express the tension of vapours. The formulæ given are :-

 $P^1 = \{0.0058824 (t + 70)\}^6 \circ \text{applicable from } 0^\circ - 100^\circ; P^1 = \{0.0064516 (t + 55)\}^6 \circ \text{applicable from } 50^\circ - 200^\circ; P^1 = \{0.0071069 (t + 41)\}^6 \circ \text{applicable from } 220^\circ - 365^\circ.$

P = [0 007/009](* 7 + 1)! approximate to calculate P, of which tabulated values are given —On the rejection, by the for which tabulated values are given —On the rejection, by the control of the second of the seco the dog's liver after injection; thus an indisputable proof

ven that the liver takes out bile constituents from the blood. and passes them into the alimentary canal unaltered.

Academy of Sciences, July 4-M Plateau in the chair,
—On hour frosts, by M Polie. Some observations of the
reages caused by frosts which occurred on June 22 and
rarges caused by frosts which occurred on June 22 and
preserved from such disastfous effects, the plateau must be
gam planted with treet. The frosts appear to have had
more effect near the soil than at some metre above it.—

the plateau must be
celesation of M. Hernite's law of respiretty, by M. Jacques
Denyts —On two new Lerneopodiass, one of which is found
the Assers, and the other on the coast of Senegal, My M. Jacques
Hirstakelia chrown found at the Azores, and of male and female
manadatia chrown found at the Azores, and of male and female
manadatia chrown terms of
plateau of the plateau of
manadatia chrown terms
manadatia
manad

SVONEY

Royal Society of New South Wales, July 1—H. C Russell, F.R.S., President, in the chair.—Eighteen new members were elected, and the following papers were read:— On Nos 13 and 14 compressed-air flying machines, by Lawrence Hargmay—Some folk songs and mythis from Samoa, translated Itargrave —Some folk songs and myllu from Samoa, translated by the Rev G Pratt, with introductions and notes by Dr. Ohr Fraser —On a cyclonic storm in the Gwydir district, and Pra-parations now being made in Sydney Observatory for the pho-graphic chart of the heavens (dilustrated by photographs), by II. C. Rusell, P. R. S. Gowsenwan Astimachus Russell, F R S . Government Astronomer.

BOOKS, PAMPHLETS, and SERIALS RECEIVED. BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Rubble (Scale, Part 7) G. B. Biction (Macmilla)—Bibliopheca

Buch (Scale, Part 7) G. B. Biction (Macmilla)—Bibliopheca

Musum (Natural History), B. B. Nevico (London)—Josai Busany, H.

Griff as Solan-Lababot, remailated by H. B. F. Lorracy, record by J. B.

better Bond J. G. Hagen (Berlin, Dismey)—Missour Bolancat Loribe

cond Annual Report (S. Louis, No.)—Bilatoris 'Northe Radges, No.

Charlos of Windrey (M. Berlin), Dismey)—Missour Bolancat Loribe

for the Company of the Company of the Company of the Company of the Company

H. Loca and W. B. Hennisty (1 (1000)—Philitims do in Second Massaw)—Papers and Proceedings of the Royal Society of Lababon for Hospitalisms.

CONTENTS.	PAGE
The Report of the Board of Trade Committee or	a
Electrical Standards	. 417
The Congress of Hygiene	419
The British Association:-	
Section E (Geography)-Opening Address by E. G	
Ravenstein, F.R.G.S., F.S.S., President of	ſ
the Section	. 423
Section II (Anthropology)-Opening Address by	
Prof. F. Max Muller, President of the Section	. 428
Electrical Standards	434
Notes	435
Our Astronomical Column:-	
Stars having Peculiar Spectra	438
Photography of Solar Prominences	438
Encke's Comet (c 1891)	
A New Asteroid (911)	438
Jupiter and his Markings. By W. F Denning	
Scientific Serials	439
Societies and Academies	
Books, Pamphlets, and Serials Received	440

THURSDAY, SEPTEMBER 10, 1801.

AN EVOLUTIONARY CASTIGATION.

Science or Romance? By the Rev John Gerard, S.J.
(London, Catholic Truth Society, 1891)

HAT the doctrine of evolution should not be as sweet savour in the nostrils of the writer of this little book is in no way surprising, but that he should attack evolutionists and their ways with the weapons of flippancy and ridicule is an encouraging indication that the said doctrine has penetrated into quarters from which the author evidently thinks it high time to eject this modern heresy Having seized the scourge, Father Gerard accordingly proceeds to lay out all round, delivering his blows with vigour, if not with discrimination. and occasionally throwing such force into his strokes that the lash recoils and strikes the striker. In happy unconsciousness that he hits himself quite as often as he does his adversaries, the author goes on with his flagellation through six essays occupying 136 pages of somewhat close print. Although, as we have said, the attitude taken by the author will cause no astonishment, it is very much to be regretted that he has so far put himself out of harmony with the spirit of modern biological thought as to confuse the opinions, speculations, and working hypotheses of individual exponents of evolution with the broad principles of that doctrine For, however distasteful it may be to hather Gerard, it is an indisputable fact that the acceptance of that doctrine is well-nigh universal. and the question whether evolution is or is not a modus operands in nature, has passed beyond the phase of discussion among scientific thinkers and workers. So far as the author's attacks are directed against evolution as a principle, his weapon is as a bladder of air against the hide of a hippopotamus. It is satisfactory to find, however, that amidst the whizzing of his flagellum the author discerns the still small voice of reason :--

"The one fact given us, is the existence of evidence to show that various species of plants and animals have probably, or possibly, been developed one from another This, so far as it goes, is matter for scientific treatment, and the theory of evolution, within the limits thus afforded, has a right to be called a scientific hypothesis."

We are grateful for small mercies, and it would be ungracious to inquire too closely into the origin of this concession, but to those who read between the lines it will be apparent that the thirty years' campaign carried on by evolutionists has not been without result, even in the most unpromising fields.

The antagonst whom evolutionasts in general and Darwinnas in particular have found in the author of the work under consideration is a foeman not altogether unverthy of their steel. He brings into the arena a certain amount of knowledge of living things which indicates that he is an observer of nature in the field Moreover, he shows some understanding of his subject, and does not fall into the error of substituting blundering misconceptions for the statements of fact or theory which he is combating. Added to this there is a certain keenness of satire running through his essays which adds to their piquancy. The name of Father Gerard on the title-page

is a sufficient indication that evolutionists will find death and no quarter in his pages, and the reader will not be disappointed if he turns to these essays with the special object of finding the weaknesses of the modern school object of finding the weaknesses of the modern school expoged. But while the purely destructive attacks of the reverend critic may give satisfaction to those who helong to his school, the impartial reader will derive only amusement, and the man of science will soon perceive that the weapons of attack are not the legitimate implements of executific warfare, but the trucks of disputation concealed under a somewhat allump literary cloak, embellished here and there with a few flowers of the author's own culling

Having arrived at this general estimate of the work, it will not be necessary to do more than take a passing glance at its contents. The first csay, entitled "A Fangled Tale," opens with an attack ou natural selection, the author will have none of it, he objects to the term and he denies its efficiency.

"It would, in fact, be vastly more likely that we should cast aces three hundred times running, with a pair of unloaded dice, or tows 'fails' two thousand times with an honest coin, than that a development should be handed down by natural selection through ten generations, even if we start with so favourable a supposition as that one-half of the offspring tend to vary in the required direction."

This conclusion is based on a calculation in which the whole principle of selection is ignored?

The central idea of this essay is, that evolutionists have reduced the operations of Nature to "chance," "accident," and so forth We are told, at the very outset —

"The cardinal point of the doctrine they proclaim is, that no purpose operates in Nature, and that the explanation of everything we see is to be found in the mechanical forces of matter"

In order that there may be no misunderstanding as to what the author means by chance, he defines it as " the coincidence of independent phenomena-that is, of phenomena not co-ordinated to an end." By what criterion. may we ask, are "chance" phenomena, as thus defined, to be distinguished from "pre determined" phenomena? Prof Huxley's example, quoted from Darwin's "Life and Letters." is critically dealt with, and the author tells us that this is "utterly wide of the mark. The phenomena here described [a storm at sea] end with themselves, they lead to nothing else; nothing follows from them They are mere effects, and not, so far as we know, a means to obtain a result beyond" The insight which the author appears to have gained into the motive, or want of motive, in nature is really most enviable; the man of science who must perforce arrive at his conclusions by the circustous roads of observation and experiment can only look with admiring wonder upon a method which is so completely foreign to his philosophy.

This same dummy, chance, is well belaboured throughout; among the slam, after this first lit, we find not only Prof Husley, but Andrew Wilson, Oscar Schmidt, and, above all, Mr. Grant Allen, whose form is so terribly hacked that he appears to have been in the very centre of the fray, if not the chief object of attack

Tilt the second is headed "Missing Links," and the onslaught begins upon Mr. Wallace, whose work on

"Darwinism" appears to have been published in the interval between the first and second essays And here -perhaps not altogether disconnected with the appearance of Mr. Wallace's book-we find that the author has executed a series of mental evolutions with such skill that we have to rub our eyes in order to make sure that we have not deceived ourselves as to the position which he has actually taken. For natural selection, which, in the first essay, was considered to be so feeble as to be incapable of carrying on development through ten generations, even with the most favourable assumptions to start with, is now considered to be "as yet but hypothesis. and hypothesis which needs confirmation from fuller inquiry into the facts of the case, just as much as the other hypothesis of the continuity of forms between one species and another" At any rate, we seem to be justified in concluding from this that, as a scientific hypothesis, natural selection ranks with evolution, which, we were told in the first essay, had a right to be so called The change of front has been very skilfully made, but that there has been a change is evident from the foregoing extracts

The way in which evidence, which has been hitherto considered as fairly good from the evolutionist's point of view, can be manipulated so as to bear the quite opposite interpretation, is a study in intellectual jugglery which might be worthy of serious attention by certain classes of politicians. The second essay furnishes several examples of such feats More especially may attention be called to the remarkable way in which the palæontological evidence is thus disposed of, and still more remarkable is the author's Podsnappian dismissal of the embryological evidence. Wallace's later treatment of natural variation is accepted .-

"The variations of form and structure which occur among wild animals—and the same is to be said for plants—are not occasional and minute, but incessant and important. There is clearly an end of the objection based on the supposed infinitesimal character of

But if the reader fondly imagines that this admission brings the author any nearer to Darwinism he will be grievously mistaken For in this larger and more widely divergent variability Father Gerard sees a "centrifugal tendency" by which "every varying climate and soil and circumstance on the face of the globe should make its own species, or rather there should be no species at all, but a fleeting and evanescent succession of individual forms, like the shapes of clouds in a windy sky" Of course, evidence has to be adduced in disproof of this astonishing result, to which the later study of variability has led us, or rather should have led us But there is no difficulty at all about this the house sparrow and the water-crowfoot, we are told, are widely distributed over the face of the globe, and yet retain their specific forms and characters True, but the instances of cosmopolitan species retaining their distinctness are few and exceptional: we are not told anything about local forms and races, or about "representative species", we hear nothing about widely distributed species which merge imperceptibly into each other to the utter confusion of those who make species their particular study Can it be that these facts

author discovered some absolute criterion of species? If the latter is the case, he can hardly be congratulated on his definition -

"It would seem to be simpler and planer to say that a species is a permanent group [italics mine] of plants or animals framed in all particulars after a single type."

Enough has been said about this work to indicate its general tendency its tone, on the whole, is antagonistic to evolution, but with respect to the special Darwinian form of this theory antagonism but feebly expresses the author's attitude In each essay, the attack generally centres upon one or two representative writers; eg. the third essay (" The Game of Speculation") dealing with Mr Wallace, the fourth ("The Empire of Man") with Prof Huxley, the fifth ("The New Genesis") with Messrs Grant Allen and Edward Clodd, and the sixth (" The Voices of Babel") with a number of miscellaneous authorities, such as Mr Herbert Spencer, Mr. Frederic Harrison, the late Prof W. K Clifford, and Sir James Stephen, of whom the author makes horrid examples by the very simple expedient of pitting their opinions against each other. From this general view, it will be seen that, so far as science is concerned, the effect of Father Gerard's last production will be practically m/ Among certain classes of general readers it may be mischievous, but we do not imagine that the mischief will spread very far. As the criticisms are for the most part destructive, it is impossible to attempt to deal with them in detail in these columns Where it is possible to glean a vestige of a constructive idea, it will be seen that the main point towards which the author appears to be driving is that the doctrine of evolution-especially in its Darwinian form-is destructive of the notion of preconceived and determinate "plan." eg. .--

"Intrinsic forces working definitely towards one play not indeterminate forces swept hither and thither by external agencies like a cloud of dust, are suggested by the phenomena of nature"

We have become so accustomed to this style of criticism from all kinds of anti-evolutionary writers that it is almost superfluous to attempt to deal with it again But it may really be asked whether those who are so constantly dinning this idea of a "plan" in nature will now condescend to give us some idea what that plan is. If "intrinsic forces are working definitely towards one plan," surely the author to whom has been permitted this glimpse into the inner sanctuary might enlighten the outer darkness a little by telling us something about the general scheme, or, at any rate, by giving us a notion as to the method by which he has arrived at such an important conclusion On the other hand, if the author is satisfied that there is such a pre-arranged plan-whether he reveals that plan to the uninitiated or not-I, for one, fail to see how evolution. Darwinian or otherwise, has anything to do with the matter. If Father Gerard has managed to extract from the writings of popular authors, this notion of antagonism between ideas which are not necessarily antagonistic, with these authors must rest the responsibility. It cannot be said that the castigation which he has inflicted is altogether unmerited; there has been a great deal of crude and hasty speculation perpeare inconvenient and "not to be endured"? or has the trated in the name of evolution, and the blows aimed do occasionally tell in the right direction. Had Father Gerard not sacrificed his position by aiming so much at smart writing—had he favoured us with more solid thought instead of endeavouring "to split the ears of the groundings"—his lucubrations would have received more respectful attention. But satire and cynicism, interspersed with ridicule, are not the best methods for securing consideration from men of science, and it is surprising that the author should have resorted so largely to their use. R. MENDIA.

THE LAWS OF FORCE AND MOTION

The Laws of Force and Motion. By John Harris (Kuklos). (London Wertheimer, Lea, and Co, 1890)

In his preface the author, very rightly, sounds a warning note against the arrogance of Conventional Science, in its tendency to become ultra-conservative, intolerant, and extremely dormatic

But Real Science will always welcome and encourage attack and contradiction, feeling sure that Truth will ultimately pread in the consensus of the majority who have devoted themselves dispassionately to the consideration of the facts in dispute. 'Transibunt multi et augebit Scientia'"

We presume the author would not ask to be judged with more leniency than he has displayed for the opponents he has singled out, so we may say at once that, after careful winnowing, we have not secured those grains of fact and truth which we were led to expect

The experimental apparatus described seems carefully constructed and suitable for exact measurements, but does not differ essentially from that employed by Smeaton more than 100 years ago. However, the author assumes the true scientific sceptical spirit, in refusing to accept implicitly the statement of theoretical laws without putting them to the text of markitale accurate many fraction.

Mathematicians will understand the nature of the author's attacks on Conventional Science from the specimen on p 31.—

"It would seem that, some time ago, a highly influental party of natural philosophers (Lehnix, the two Bernoulis, &c) entertained and supported the idea that the momentum of a moving body varies as the square of the velocity. This idea or conclusion was probably based on an inference, that, since a double velocity of the resistance required four times the force to produce is, four times the momentum must have been imparted to the resistance."

After this wavering as to the meaning of momentum, we are quite prepared to find (p 60) that the author is of the school who declare that the moon does not rotate.

The author cannot decide between 16'1 or 32'2 for the value of g (p 24); and cannot settle in consequence whether the normal acceleration in a circle is the squared velocity divided by the radius or by the diameter (p. 19).

"Tangential force" is, in the author's opinion, a more correct scientific term to use than "centrifigal force," although he allows that the latter is ballowed by long usage; but in his treatment he enunciates a theorem p.21, "The actual lineal ratio of the sine to the arc, when the arc is an octant; is 9 to 10," quoded from his own "Treatise on the Circle and Straight Lines"; this makes

 $\pi = 2 \sqrt{2 + 0.9}$, a result worth recording by collectors of mathematical curiosities.

We hoped to find something combative in the articles on the Tidal Effect of Lunar Gravitation (p 57), and on the Moon's Gravitative Influence at the Equatorial Surface of the Earth measured by Pendulum Oscillations (p 76), considering that even the great Abel wint astray in his theory at this point; but our author confines himself to vague generalities.

He would perform a valuable service to Science if he employed his experimental skill in observing the effect of Lunar Gravity on the Seconds Pendulum, as Conventional Science asserts that this effect does not amount to more than a rate of one zooth of a second in the day, although so noticeable in the Tides

"Some Propositions in Geometry," by the sanie author, is advertised at the end of the book, whereof the Trisection of the Angle, the Duplication of the Cube, and the Quadrature and Rectification of the Circle, occupy the chief part, but we wonder whether the author has quite settled in his Geometry that the versed sine (or vertral height) is proportional to the chord, in a circle (p. 71). This might have been a misprint, but that the author adds immediately a numerical illustration, by saying that, if the chord is duplicated, the versed sine is also duplicated.

And this homely mode of verifying a law of comparison, by halving or doubling some quantity, and then observing the consequent change in the phenomena; is the single idea we consider worth lifting from the book, for general purposes of convincing argument and illustration of a mathematical law A G G

OUR BOOK SHELF.

An Introduction to the Mathematical Theory of Electriuty and Magnetism. By W T A Emtage, M.A. (Oxford Clarendon Press, 1891)

THE want of a text-book especially designed for the use of candidates for examinations in which a knowledge of the more elementary portions of the mathema-tical theory of electricity and magnetism is demanded has been felt for some time. Though the absence of such a book has caused some inconvenience, we are not at all sure that it has been detrimental to the study of electricity, for hitherto the candidate for a mathematical examination in electricity has been compelled to learn the subject from books such as those of Maxwell, or of Mascart and Joubert, in which electricity is treated as what it really is outside the evamination-room-a subject in which mathematics and experiment are closely mixed and mutually helpful. it is to this that, we think, is to be ascribed a good deal of that interest which electricity, above all other subjects, seems to excite in its students. When, however, the analytical parts of the subject are divorced from the experimental, we do not believe they will be found to excite any special enthusiasm, or that the result will be much more interesting than an ordinary text-book for the Mathematical Tripos on, say, hydrostatics

There is no doubt, however, that there is a demand for a text-book suitable for examination purposes, and this demand will, we think, be well met by the book before us. The scope of the work may be described by saying that it includes nearly all the analytical parts of Maxwell's larger treative which do not involve analysis higher than the simpler parts of the differential and integral calculus;

it thus covers the portions of electricity and magnetism which, under the new regulations, are selected for examination in Part I of the Mathematical Tripos, and we have no doubt it will be found useful for that examinations are generally clear and concise. Among const minor, onto the control of the contr

Le Sommeil et le Système Nerveux Physiologie de la Veille et du Sommeil. Par S Serguéyeff (Paris: Felix Alcan. 1800)

It is difficult to understand why a writer upon the higher branches or outlying districts of neurology should assume that his readers are totally ignorant of the radiments of that science, and should occupy nine-tenths of his book with a description of the anatomy and physiology of the nervous system—If, indeed, for the purpose of throwing new light upon his subject, he presented his facts in a new form, or taught them from a novel point of view, or arranged them so as to bring out some new principle, then arranged them so as to bring out some new principles, time-there might be an excuse for restating the facts , but even them a brief summary would be enough for the pur-pose, there would be no need for the rediscussion of settled theories and the requestation of trite authorities Scarciely ever do we find a writer on neurology who is content to assume that his readers are acquainted with the alphabet of his subject, or who will refrain from inflicting upon them the wearisome account of cells and fibres, of corona and cortex, illustrated by the familiar engravings that have done duty in so many previous books. The vicious habit is common enough and bad enough, but very rarely is it carried to such an extent as in the book before us, in which only about three hundred out of the seventeen hundred pages of which it is composed are devoted to the subject of which it is said to treat, the great bulk of the subject to which it is said to freat, the great blik of the book being occupied by anatomical and physiological descriptions which are not in this case even relieved by illustration. So far is this system of padding carried, that the author has even inserted, in his book on waking and sleeping, descriptions of the minute structure of the retina, of the internal ear and the organ of Corti When we have at last waded through his pages of preliminary matter, we do not find that he presents any fresh theory of sleep that is worth considering, or that he has any new facts to bring under our notice It is a shanie that a student should be trapped by an enticing title into spending his time in reading such stuff

Elementary Science Lessons By W. Hewitt, B.Sc (London: Longmans, Green, and Co, 1891)

THE thirty-six object-lessons contained in the present volume form the third part of a scheme of lessons drawn up by the author at the request of the Liverpool School Board. They are designed for children of Standard III, and are in continuation of others given in previously pub-

NO. 1141, VOL. 44]

lished volumes suitable for Standards 1 and 11. The author's long experience in teaching science to children in elementary schools gives him the ability which is mecessary properly to draw up such a course as the one before us. For the most part the facts and principles dealt with relate to the classification of bodies into solids, the same of the solid principles of a paratus, and the inferences to be drawn from them must be manifest to all children for whom the work is intended. Whenever possible, the principles considered in the lessons are applied to explain physiographical phenomena, thus ading the development of that imtelligent observation which is the generally good, and elementary school teachers will find in the work exactly what they require for their pupils

Solutions of the Examples in Charles Smith's "Elementary Algebra" By A. G. Cracknell (London Macmillan and Co., 1891.)

Most a state of the state of th

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Niether can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communication:

The Anatomy of Heloderma,

This number of Nevuus for July 30, which I have only just seen, contenting 10, agoly a criticism of a sistement of mane, to which I have to asswer It is stated in my paper on the oncology of Holderma that there are eight or mine premarable years of the property of the p

A Straight Hand.

ALTHOUGH my writing master, who was an Englishman, taught me stanting letters which old habit still clarge to, I approve highly what you as a geainst it (NATURE, August 6, p 335). Allow me to add some remarks on another side of that question. For many years past I have had in succession several amanucases, and my first care has always been to require a straight hand without any clittantollo between up and down

sirokes These precepts and a few minor ones have been easily followed in all cases. I inclose a few lines copied from your interesting journal by a youth who does not understand English he would have done this work with more care had he known that I wanted merely a sample At all events it is most easy

Straight letters without hair lines give the reader a comfortable Straight letters without hair lines give the reader a combrabile callify which is a far greater compliance to a correspondent than facility which is a far greater compliance to a correspondent than last fifty years. We suppose that alant writing has been invented on your side of the Channel, and we call it therefore circlive any fairs. However, experience seems to show that it is more easily deformed than a straight one, and that it degenerates more easily detormed than a straight one, and that it degenerates often into an inlegible scrawl, cassing much loss of time, or even, often into an inlegible scrawl, cassing much loss of time, or even, are told that the schoolmatter is abroad, but I am afraid that he leads our children on a files trail far away from the man aim of writing, which is legislaty. Is the invention of type writers the antidote or the outcome of illegible slanes? Some of your philosophers may answer this question while giving a wholesome lesson to the schoolmaster.

A D'ABBADIE (de l'Institut)

Abbailia, Hendaye, France, August 16.

Cordylophora lacustris.

IN NATURE for June 4 (p. 106) Mr. John Bidgood recorded IN NATURE (of) june 4 (p. 105) Mr. John Biagooti recorded the pre-ence of this Ilydrozon in wast musibers on «shimerged roots and stems in the Ant, Bure, and Thurne — Islt then its only known Norfolis locality was that given in Allman—"in a agricultural drain near Lyan Reght." This summer innumerable coloniem were to be seen on weed floating on the surface on both sides of the Thurne from Ludhain Birdge right up to Hicking Broad. A boatman told me he had ween. "then isnesses" every Broad A boatman told me he had seen "then insees" every sammer for many years past Mr Edward Corder, the Secretary of the Norwich Natural Flutory Society, took some early in June, and some, which he was good enough to send me, is still living in a 4 ounce bottle All the authorities tate that Cordylophora is a "light shunning animal," and the localitieshitlicrto recorded certainly warranted such a conclusion. But the colonies taken from the surface of the water by Mi. Corder, and coionics taxen from the surface of the water by Mi. Corfier, and those. I took some time later, were stronger and cleaner than those obtained from below the surface. I distributed some of the gathering which I brought back to London, and learn that it is all doing well in ordinary aquarta. Some that I sent to Mr Bollon for distribution unfortunitely died in transit. One to Mr. Botton for distribution under the stem of a Potamo geton, was kept in the shade for a fortinght, the tubes became faced, and the hydranth pendent, but they revived within twenty-four hours when exposed on the ledge of a window with a western sapect. This seems to point to a change of habit All the colonies were doubtless founded below the surface of the water, and the weeds, when cut to clear the fairway for wherries, were floated up lowards Hickling Broad by the tide But if reproduction takes place—as it certainly does—under these conditions, is it not probable that we shall have a race tolerant of direct light, if not as sensitive thereto as Hydra HENRY SCHERREN.

5 Osborne Road, Stroud Green, N . September 3

Absolute and Gravitation Systems

Absolute and Gravitation Systems
Tita present condition of things is such that students of engineering need familiarity with, and shishy to use, both systems of measuring force and related quantities. It seems necessary, so that the state of the state

There is, in my opinion, much that is undesirable about this method of statement; the new mass-unit appears quite artificially in this one only of the many uses of the conception of mass, for the purpose, I suppose, of making it possible to put in

generally applicable form such statements as "Force is measured by change per second in momentum" My particular objections to it, however is that it locates the point of divergence of divergence of divergence of the control of the that the force unit is the first cardinal point of difference, and that the absolute system simplifies here, while the gravitation system adopts another convention, which may be called arbitrary as opposed to the simpler one fixed upon by its rival.

In the hope of hastening the day of agreement in presenting the connection of ideas which underlie so much of modern physics and its applications, I have thought it permissible to state in summary, and for British units, the scheme used in my own teaching of mechanics. The claim is not advanced that the numerical work becomes different, indeed, the appended table is equally valid whichever basis be chosen, but there does seem to be a gain in logical clearness, as well as in what we

may call historical accuracy

Absolute System — Fundamental units foot, pound, second
Units of force, work, impulse derived in the usual way, so as to

make proportional factors unity make proportional factors unity

Gravilation System — Fundamental units as hefore Unit of force, the weight of one pound under circumstances specified to the required degree for scientific definiteness (locality, vicuum)

the required degree for scientific definiteness (locality, vecuum) Units of work and impulse connected with the force unit, so as the control of the scientific of the standard of the control of the standard currents are glance y, is the value of for the standard currents areas, and is to be regarded an other or in each case affecting the product of the other factors. The other symbols explain themselves

$$\begin{aligned} & I h w h w \\ & P - m h, \\ & (work) \int P J h = (change in) \frac{m v^2}{2}, \\ & (impulse) \int P J H = (change in) m v \\ & Grat that to v \\ & P = \frac{m f_1}{2}, \\ & (work) \int P J G = (change in) \frac{m v^2}{2}, \\ & (umpulse) \int P J H = (change in) \frac{m v^2}{2}, \end{aligned}$$

$$(umpulse) \int P J H = (change in) \frac{m v^2}{2}, \\ & (umpulse) \int P J H = (change in) \frac{m v^2}{2}. \end{aligned}$$

I be choice of force unit here affects what is logically subsequent to it, as it must, but leaves inaffected what is logically

quent to it, as it must, but leaves intartected what is logically netcoclent, as it ought.

So small a change as that of regarding g₁ as a divisor of m alone changes the basis of pre-entation, but there is an important difference of thought involved.

Exemption of California

University of California

Eucalyptus as a Disinfectant

In a paragraph on the use of Eucalyptus branches for disin-fection, as recommended by Baron von Mueller, you have un-intentionally stated that to be the manner in which I have used **Facalyptus**

Facelyptus

For the last two years I have used "Tucker's Eucalyptus Disinfectant" (a solution of antiseptics in the essential oil) in all
cases of scarlet fever and diphtheria, and have not had one case
of infection. In the former disease I have not used any nolation, and in most cases have not excluded the other children of tion, ann in most cases have not excluded the other children of the family from the sick room. None of the cases, except two or three that were severe, were kept to their bed-room more than ten days; the solution of as or eight weeks being unnecessary, as the cutted is perfectly disinfected. This is accomplished by rubbing the disinfection to ver the whole body twice and their once a day for ten days.

Baron von Mueller, in a letter I received from him, quite approves of my method of disinfecting by inunction. I read a

paper before the Epidemiological Society has year on the subject. It is published in the Society's Transactions, and in a separate form by Mr. Lewis, of Gower Street I also read a paper before the International Congress of Hygiene on antiseptic insuction I mis I have related the experience of other medical men in confirmation of my own. One, whose child had scarlet fever, placed his two other children in the same room, and kept them there for eight days, and they did not take the disease. This will be published in the Transactions of the Congress, and any one interested in the disinfection of infectious diseases, may obtain all the information they require from those two papers.

I Brandon Curgenvan.

Teddington Hall, S. W., August 17

Alum Solution

ONE frequently reads, in accounts of experiments on the physical or chemical action of lemmons rays, that a solution of instancial reads of the control action of lemmons rays, that a solution of lemmons rays, that a solution of the solution of the reservoir action of the solution of the reservoir action of the solution that, because alam stelf cuts off a garge proportion of heat rays than any other easily available control of the solution of solid, its solution should be more effective than any other liquid sould, he solution among the more energies that hay write singular. The only figures bearing on the question with which I am acquainted are those of Mellom, and he, as cited by Ganot, states the percentage of heat rays transmitted by alum solution states the percentage of near rays as 11. Why, then, not as 12, and that by distilled water as 11. Why, then, not a HARRY NAPIER DRAFER. Why, then, not use Dublin, August 27

A NEW KEYED MUSICAL INSTRUMENT FOR TUST INTONATION

ONE of those subjects which periodically turn up for discussion, and then vanish for an interval of neglect, is the possibility of obtaining just intonation in the performance of music. I hose who have studied theory, properly so-called, know very well that the series of musical sounds commonly used, as expressed on the planoforte, do not give the true harmonic combinations on which the art is based, and many zealous attempts have been made to cure the evil One of these, showing some novelty and much merit, is now exciting the attention of eminent musicians on the Continent, it was men-tioned briefly in NATURE of April 2 last (p 521), and it may be interesting to many readers to give some further account of its general features We may, however, preface this with a few words on the state of the question generally.

Although the equal division of the octave has now taken such a firm hold on modern musicians, it is only within a comparatively recent period that its use has become common It was well known at an early date, but its defects checked its use until the general introduc-tion of the class of instruments which have culminated in the pianoforte; the reason of its adoption then being that the want of sustaining power in the clavecin and the harpsichord so diminished the discordant effect as to make the faulty tuning endurable People then began to get accustomed to it, and it was soon found that the system gave such extraordinary facilities for chromatic music, that the cultivation of this style became enormously developed. Hence the chromatic style and the equal temperament have become closely allied, and it is almost a matter of doctrine that the pianoforte division of the octave is a necessary element for the proper performance, or proper understanding, of the compositions of modern days.

For organs, the application of the equal temperament came much later Down to about the middle of this century they were tuned on a system which gave the most usual keys fairly in tune, at the cost of an occasional harsh chord, which, for church purposes, was considered

but a small price to pay for the general smooth and har-monious effect. But when highly skilled players began to increase, they required the organ to be more used for exhibition, and for this purpose the introduction of the equal temperament was deemed desirable. And so, as it thus commanded the two most powerful sources of music, it crept into use also by stringed instruments, orchestras, and voices, and so it has become general.

The consequence is that, now, practical musicians are in the habit of accepting the equal-tempered intonation as genuine and true music, and as the study of the prin-ciples of musical structure is by no means highly en-couraged in this country, efforts are seldom made to undeceive them. Students are authoritatively told that questions about just intonation may be interesting to physicists and mathematicians as recondite problems in acoustical science, but that they have no bearing on "practical" music, and that, therefore, musicians need practical music, and that, therefore, musicians need not trouble themselves about them. Some years ago, at a meeting of one of our musical educational establishments, it was said, "We do not here make music an affair of vibrations"—a sentiment which was received with loud applause

No doubt some enthusiasts have carried the investigations on this subject to a degree of refinement which far outruns practical utility, and one can have little sympathy with those who delight in reviling and despising the duo-decimal scale, seeing that it has been the means of materially advancing the art, and that the modern enhar-inouic system, founded upon it, has been so thoroughly incorporated into modern music that it is difficult to see how it could be now ignored

But, on the other hand, one must, if one is to exercise reason and common-sense in musical matters, be equally reason and common-sense in musical matters, we equally at variance with the party who, arrogating to themselves the title of "practical" musicans, force on us the equal temperament to an extent which really means the extinction of true intonation altogether. We now, indeed, never hear it, and in fact only know by imagination what a true "common chord" means.

The principal objection to this state of things is that he ears of musicians become permanently vitiated, and lose the sense of accurate intonation, or the desire to approach it, which is tantamount to abandoning the most precious feature that modern music possessesnamely, beauty of harmony. A chord of well selected sounds, exactly in tune, is a very charming thing, but it is a thing unknown to ears of the present day 1 can recollect the time when singers and violin-players strove recollect title time when singers and violin-piayers surve to sing and playin good tune, and the effect of such un-accompanied part-singing, and such violin-playing, was very delightful. But now, music not being made "an affair of vibrations," one is often ashamed of the quality of what one hears; nobody seems to think purity of harmony, either with voices or violins or orchestras, to be a matter worth striving after

It is surely a reasonable wish that this should be checked, but one must be reasonable in one's expecta-The pianoforte must certainly be let alone, and so must the organ when used for exhibitional purposes, though its cacophony under the present tuning detracts much from the pleasure of hearing such fine playing as is now common. But vocalists and violin-players ought to be encouraged, as of old, to sing and play in tune, and for this purpose what is wanted is an instrument which will keep up and circulate the tradition of what true music means. To attain this, therefore-te to construct an instrument which shall enable a player, with moderate ease, to play polyphonic music, of moderately chromatic character, in strict tune—has been the aim of many ingenious musicians and mechanics.

I need not go into history. Everybody may see at South Kensington the wonderful enharmonic organ, built half a century ago by General Thompson, and may read of the instruments described by Helmholtz, and his voluminous commentator, the late Dr Ellis: and the efforts in the same direction of Mr. Colin Brown, and of Mr Bosanguet. who has devoted much attention to the matter, are worthy of all praise But my object now is to describe but my object now is to destroe the latest attempt of the kind, by a native of Japan, Dr. Shohé Tanaka Persons who have lately had to do with that country have been well aware, not only of the natural ingenuity of the Japanese, but of the high standing which many of their youth have taken in scientific studies. Dr Tanaka combines these two qualifications After an industrious preliminary education in his own country, he went to Berlin, where he has been for five years studying physical and mechanical science under the best professors, and with these he has combined also a study of music. He has published, in the Vierteljahrsschrift fur Musikwissenschaft for 1890, a long essav on the subject generally, which fully demonstrates his on the subject generally, which fully demonstrates his knowledge of it, and he appears to have made a very favourable impression in Germany. He exhibited his "Enharmonium," as it was called, to the Emperor and Empress, and he produces testimonials from many musicians of the highest rank, among whom are Joachim, Von Bulow, Reinecke, Richter, Fuchs, Moszkowski, the whole staff of the Leipzig Conservatoire of Music, and many others These not only speak highly of the instru-ment, but (in strong contrast to the English authorities) earnestly support and recommend the object it is proposed to serve Indeed, some of the testimonials are Von Bulow especially says -

"I have requested the maker to make me such an enharmonium for my personal use at home I am earnestly desirous to protect myself during the few remaining years of the exercise of my art against constantly possible relapses into already conquered errors. In order to make pure music it is necessary to think in pure tones It is default to make pure music it is necessary to think in pure tones It is default on which nearly all corruptions of hearing paniofortie let on which nearly all corruptions of hearing

may be traced "
With these credentials the inventor has brought a
sample of his instrument for examination in England,
and I may proceed to give some idea of what it is like.

The great object to be aimed at is facility of performance. It is in this respect that most of the former instruments have failed; the multitude of notes has generally required a new kind of claver, or the manner of manipulating them has been so complicated and difficult as to require a special learning attended with much rouble. The required a potential learning attended with much rouble. The Key-board modelled precisely on the usual pattern and use. But T. Tanaka has gready simplified the problem by adopting the transposing system, often adopted with pannofortes Whatever key the music is in it, it is played in the simplest of all keys, the key of C, and by means of a bodily shifting of the key-board to the right or left, it is set so at oact in the key required. It is, in faci, the principle used in the music in the key of C, and the transpostance of this to the key required is previously arranged as a part of the mechanism of the instrument; or, rather, as the author puts it, the music may be read and played on the tone sold-in system, and her might have adopted its symbols

if he had not feared it would be too startling a change. The points in which the new key-board differs from the ordinary one are, that the black keys are divided, some into two and some into three parts, and one additional shorter and narrower black key is introduced between the Z and F white keys. This arrangement gives twenty notes, which suffice for modulating into a reasonable number of keys with sharp signatures.

To provide for modulations into keys with flat signatures, since these and the sharp modulations are not NO. 1141, VOL. 44 both wanted at the same time, six of the notes can be instantaneously changed for the purpose, at any time, in a manner hereafter explained

The whole of the keys are well under the hand, and, if the performer knows which note he ought to use, he can take it in any usual chord without difficulty.

Fig 1 represents one octave of the key-board as arranged for the key of C, with provision for modulating into keys with sharps.

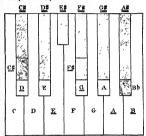


Fig. 1 -As arranged for modulation into keys with sharps

In order to explain the exact intonation or muscal position of the notes, the author adopts a notation already pretty well known—namely, when the letter indicating a note, has no line above or below it, it is intended to correspond with what may be called the "Pythagorean" fifth upwards from C. 4s a base. If the letter has a stoke below it—thus, E—it is a comma below that position, and if the stroke is above—thus, 5—it is a comma above that position. Two strokes below—thus, Cg—nultrait two commas below.

indicate two commans seew with the confinary seem white the many seem white the seem ordinary notes of the major scale of C, according to the intunation usually understood, et the major trads on the tonic, dominant, and subdominant, being perfectly in tune liut as, for certain harmonies, variations of some

liut as, for certain harmonies, variations of some of these notes are required, there are four alternative small white notes, D, E, G, and A, placed at the near extremity of four of the black ones. For example, the note D is the one required to make the true minor third

The position of the keys for the sharp notes, and also their intonations, will be seen in the figure F # and C # each require alternative values, a comma distant from each other, and these are obtained by dividing the black keys in the manner formerly practised with some organs in this country.

It will be seen that there are in all twenty effective finger keys, each sounding a separate note. When it is requisite to modulate into keys with flats,

When it is requisite to modulate into keys with flats, the above arrangement will not answer, and the necessary change is made by a lever placed conveniently for being worked by the knee of the player, like the swell of a harmonium. When this is pushed over, the six hindmost black keys are altered from sharps to flats, as shown in Fig 2. alternative F are added This change gives six new notes, so that the total number of sounds used in the octave, for the key of C with its modulations, is twenty-six

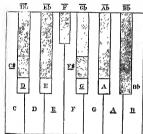


Fig. s -As altered for modulation into keys with their

As a further indication of the exact musical positions of these twenty-six notes, their ratios of vibration with the keynote C, may also be given And the logarithms of these (here limited, for simplicity, to three places) will represent approximately the height of each note above C In this scale, an octave is represented by 301, a mean semitone by 25, and a comma by 5

Table of the Positions of the various Notes used for the Key of C

C = I	Logaruhm O	Ratio	Logarith
$D = \frac{9}{8}$	51	$D = \frac{10}{9}$	46
$E = \frac{5}{4}$	97	$E = \frac{81}{64}$	102
$1 = \frac{4}{3}$	125	F = 27	130
G = 3/2	. 176	$r = \frac{40}{27}$	171
A ≈ 5	222	$A = \frac{27}{16}$	227
$B = {15 \over 8}$	273		
F# - 45	148	$F_{2}^{\#} = \frac{25}{18}$	143
$C_{\frac{1}{2}}^{\frac{1}{2}} = \frac{1}{128}$		$C_{3}^{*} = \frac{25}{24}$	18
$G_{1}^{\#} = {}^{25}_{16}$. 194		
$D_{8}^{\#} = \frac{75}{64}$. 69		
$A_{\parallel}^{\#} = \frac{225}{128}$	245		
$E_{4}^{\pm} = \frac{675}{512}$	120		
NO. 1141	, VOL. 44]		

Bb = 9 5	Logaruhu. 255	Ratio Bb = 16	Logarithm 250
$Eb = \frac{6}{5}$	79		
$Ab = \frac{8}{5}$	204		
$\bar{Db} = \frac{16}{15}$	28		
$Gb = \frac{64}{45}$	153		

This information will enable any student of musical theory to judge of the capability of the instrument to play modern music with just intonation. The great object is, of course, to play the consonant triads, major and minor, in strict time, and it will be found that the instrument, as above arranged, will play the following

> Major Triads on -C, D, E, F, G, A, B, F#, Bb, Eb, Ab, 105, Gb, Minor Friads on-

C, D, E, F, G, A, B, F#, C#, G#, D#, A#, Bb,

and some of each in displicate with a comma variation These would certainly seem sufficient for all ordinary

These would certainly seem suincient to an ordinary music in C major or A minor.

By means of the transposing movement, the key-board can be set upon either of the eleven other keys, for which a similar modulating power is obtained, except in some very remote cases In order, however, to effect this, ten additional notes are used, making thirty-six in all But the adaptation of them is entirely automatic, and the mechanism for this purpose constitutes one of the chief novelties of the invention

This is the provision for the purpose by the manu-

This is the provision for the purpose by the manufacturer Now, let us see what the performer has to do. In the first place, whatever key the original compositions in, it must be played in the key of C. In these days of strict examinations by the College of Organists, it is not uncommon to find players who can transpose at part of the property of th is nothing in comparison with the great gain in simplicity of the key-board

Secondly, the performer has not only to play the music in the ordinary way, but he has another problem before him-namely, where certain notes are in duplicate, he has to decide which of the two to use Now this, although by no means a difficult matter, requires some knowledge of the theory of music, in a sense beyond what is ordi-narily taught To explain it would lead us into more technical detail than would be proper here, but Dr Tanaka, in compassion for those unfortunates with whom music "has not been made an affair of vibrations," has shown that the printed music can have certain very simple symbols prefixed to the notes, which will easily guide the purely "practical" player what to do

In this way any competent organist, though he may never have heard of the system before, may, after a few minutes' explanation, and a quarter of an hour's practice, play any piece of music correctly in the true musical intonation, a result which, I believe, has never been attained by any former instrument, and which says much for the ingenuity of the whole contrivance
It is recorded that the Emperor of Germany expressed

a wish to see the experiment tried on a large organ, and a wish to see the experiment tried on a targe organ, and the inventor is now engaged in constructing one with eight stops, and a simplified enharmonic pedal-clavier, for the Prussian Government.

WILLIAM POLE.

THE NEW AUSTRALIAN MARSUPIAL MOLE—

O UR Corresponding Member, Prof. E. C. Stirling, of the University of Adelaide, has most kindly sent to us an original water-coloured drawing of the newly-discovered Australian Marsingh, prepared from a pencil sketch taken from life. The animal is represented upon the surface of one of the red animal is represented upon the surface of one of the red animal is represented via Arnolda Instruction, the "portugung grass" of the interior of Australia, and is figured of the natural size. The drawing will be exhibited at the first scientific meeting of this Society in November next, but in the meanwhile can be inspected in our library by any naturalist who may

Prof Surling has also sent us a copy of his paper in the Transactions of the Royal Society of South Australia (read February 3 of the present year), in which this extraordinary animal is fully described. The subjoined particulars as to its habits, extracted from Dr Surling's article, will be interesting to the readers of Nature.

"It appears that the first specimen was captured by Mr Wm Coulihard, manager of the Frew River Station and other northern runs belonging to the Willowie Pastoral Company Attracted by some peculiar tracks, on reaching his camp one evening on the linke River, while traversing the Idracoura Station with cattle, he followed them up, and found the animal lying under a tussock of spinifes or porcupine grass (Triodia pritans) Though and powers of observation usually acquired by those who live lives of difficulty and danger, this was the first and only specimen of the animal he ever saw As previously stated, this found its way to the Miseum through the agency of Messrs Benham and Molineux. The three subsequently received shortly afterwards, as well as the last lot recently secured by Mr Bishop during our journey through the country, were also found on the Idracoura Station This is a large cattle-run comprising Idracoura Station Ins is a large cattler-un comprising several hundred square miles of country in the southern part of the Northern Ferritory of South Australia, which hes immediately to the west of the telegraph line between the Charlotte Waters and Alice Springs Stations. The great dry water-course of the Finke River, which runs from north-west to south-east, bounds the run for some eighty miles on the north and north-east. Its distance from Adelaide is, roughly speaking, a thousand miles Flats and sandhills of red sand, more or less well covered with spinifex and acacias constitute a large portion of the country, and the rainfall is inconsiderable. Curiously enough, all the specimens of Notorycles hitherto received by me have been found within a circumscribed area, four miles from the Idracoura Head Station, which is situated on the Finke watercourse itself, and almost invariably amongst the sandhills I have it, however, on very fair authority, that the animal has been seen on the Undoolya Station, which lies immediately south of the McDonnell Ranges, and that one also was found drowned after heavy rain at Tempe Downs, a station situated about 120 miles west-south-west of Alice Springs These points will suffi-ciently define its range, so far as is known at present They do not appear to be very numerous Very few of the white men in the district had ever seen it, even though constantly travelling, and not many of the natives whom I came across recognized the well-executed drawing I carried with me It must be remembered, however, that I did not pass through the exact spot which so far appears to be its focus of distribution. Nor did a very considerable reward, which I offered, cause any speciconsecration femalia, which is othered, cause any speci-mens to be forthcoming between the first lot received, over two years ago, and that recently secured during my trans-continental trip. With a few exceptions, the an-mals have been captured by the aborignals, who, with

their phenomenal powers of tracking, follow up their traces until they are caught. For this reason they can only be found with certainty after rain, which sets the surface of the sand, and enables it to retain tracks that would immediately be obliterated when it is dry and loose. Nor are they found except during warm weather, so that the short period of semi-tropical summer rains appears to be the favourable period for their capture. For this suitable combination of wet and warmth, Mr. get them, and in all cases they were found during the day-time Perpetual burrowing seems to be the charactenstic feature of its life Both Mr Bishop and Mr Benham, who have seen the annual in its native state, report that, emerging from the sand, it travels on the surface for a few feet at a slowish pace, with a peculiar sinuous motion, the belly much flattened against the ground, while it rests on the outsides of its fore-paws, which are thus doubled in under it. It leaves behind it a peculiar sinuous triple track, the outer impressions, more or less interrupted, being caused by the feet, and the central continuous line by the tail, which seems to be pressed down in the rear Constantly on the look-out for its tracks, I was often deceived by those of numerous licards, which are somewhat similar in these respects

"It enters the sand obliquely, and travels under ground either for a few feet or for many yards, not apparently reaching a depth of more than two or three inches, for whish underground its progress can often be deterted by a slight cracking or miving of the suruse as a borer is made of the conical south with its horny protecting shield, and the powerful scoop-like claws (fore) are also early brought into play. As it disappears from sight, the bind-imbs, as well, are used to throw the sand backwards, which falls in again behind to throw the sand backwards, which falls in again behind for a few feet upon the surface, and then descends as before I could hear nothing of its making, or occupying at any time, permanent burrows. Both my informants land great stress on the phenomenal rapidity with which land great stress on the phenomenal rapidity with which continuity."

To these notes of Prof String I may add the remark that this is certainly one of the most extraordinary discovered in cology made of late years Notarystes (Typhole), as shown by Prof String's full and elaborate description and figures, is unquestionably 4 new and referred to a new section of the order Massupahia. We must all congratulate Prof Strings on his success in bringing before the world such an important novelty.

P L SCLATER

Zoological Society of London, 3 Hanover Square, W.,

August 20

FRANCIS BRUNNOW, PHD, FRAS

WE regret to have to announce the death of Frances
Brunnow, whose fortune it was to earn in two
continents a reputation as an ardent astronomer and an
indefatigable observer and computer. He was not less
distinguished as a Professor at Ann Arbor, Michigan,
than when he filled the Chair of Astronomy at Dublin, and
was fortunate in his early career. Nearly fifty years ago
was fortunate in his early career. Nearly fifty years ago
he was one of the band of carriest astronomers that
Encke summoned round himself at Berlin, and thus he
became the firend and companion of Galle, of Bremiker,
and of DArrest. The time too, was increasing. Adams
and the issue of that well known drams was worked out
and the issue of that well known drams awa worked out

under the eyes of the late Dr. Brunnow He was present in the Berlin Observatory when Neptune was fire recognized as a planet, and an early, if not the earliest, notification of its discovery, that reached this country, came from his hand.

It would be tedious to recall all the results that his untiring industry wrought in the department of cometary classical investigation of the motion of De Vico's comet of short period. The close and eager search that was made for this comet, particularly in 1855, was not successful, and its ultimate career is unknown; but this fact does not detract from the merit of Dr. Brunnow's memoir on which a lesser reputation might rest. As a calculator of a high order, he will, however, be remembered for his work on the theory of some of the minor planets, as Flora, Victoria, and Iris-a work which to some extent was carried out during his Directorship of the Observatory of Ann Arbor, Michigan, to which he was appointed in 1854. Here, too, he published for a short time a periodical under the title of Astronomical Notices This journal had but a short life, and judging from its rarity must have had but a small circulation. A very different fate attended the publication of his "Lehrbuch der spharischen Astronomie.' first issued in 1851, and which has passed through several editions, been more than once translated, and is everywhere recognized as an authoritative text-book In 1865, on the death of Sir W Hamilton, Dr

In 1865, on the death of Sir W Hamilton, Dr Prinnow was appointed Andrew Professor of Astronomy in the University of Dublin and Director of the Dunair Prinnow was appointed Andrews Professor of Astronomy in the University of Dublin and Director of the Dunair researches in which his illustrous predecessor had been engaged had not left him sufficient lessure to superintend with activity the affiris of the Observatory, and the work of organizing and of placing it on a modern footing, deciquately equipped, fell to the lot of Dr. Brinnow, who object-glass, which had remained unmounted, was, under Dr. Brinnow's auspices, provided with an equatorial movement, and with it he carried out the researches in stellar parallax which marked alike his assiduity and his competence as an observer. This line of research, thus sellar parallax which marked alike his assiduity and his competence as an observer. This line of research, thus count of failing health and eyesight, and he has since lived privately, principally abroad. He died at Heidelberg, in an sixty-seventhy eart, to the deep regret, not only of his his sixty-seventhy eart, to the deep regret, not only of his his sixty-seventhy very to the deep regret, not only of his his sixty-seventhy very to the deep regret, not only of his his sixty-seventhy very to the deep regret, not only of his his sixty-seventhy very to the deep regret, not only of his by his teaching, whether as members of his classic

NOTES.

THE Astralasian Association for the Advancement of Science will hold it to fourth annual meeting at Hobart in January 1892. The first general meeting will take place on January 7, when Str James Hestow will reage the chart, and Sir Robert G C, Hamilton, Governor of Tasanana and President of the Tasanana Royal Society, will assume the Presidency, and deliver an address. Visits to places of interest in the immediate neighborhood of Hobart will be made during the time when the meeting is being held, and afterwards there will be executions to deflorent places in Tasanana. Application has executions to deflorent places in Tasanana. Application has received as the control of the Company, for passages at reclined rates to members of the British Association visits of Tasanana to attend the meeting at Hobart, and it is especied that this will be granted.

THE International Electro-Technical Congress was opened at Frankfort on-the-Main on Tuesday An address was de-

NO. 1141, VOL. 44]

27

livered by Dr. Stephan, Imperial Minister of Post and Tulgraphs. Some 650 members, of whom 15% were foregagers, stateded the proceedings. After the usual complimentary speeches, the following gentlemen were cleated Fresidents of the various Sections of the Congress .—Herr Stemens, of Rerim Mr. Preco, of London; M Henpitaltes, of Paris Signor Ferrare, of Turns, Herr Waltenhofen, of Venna; and Herr Kohlarusch, of Hanover. It was deceded that a special Section should be formed to consider the principles of legulation dealing with electro-technical matters.

The Crystal Palace Lietmeal Enhibition, to be opened on January 1 test, has received the sanction of the Board of Trade, and in duly certified as an International Enhibition, under the portunous of the Patients, Deagns, and Trade Marks. Act, 1852, The exhibits of Her Mayesty's Government will include thus trocal telegraphs and electrical apparatus, instruments, and appliances, as well as the modern apparatus and instruments now in use in the Postal Telegraph Deparations. I This exhibit will be arranged under the direction of Mr. W. H. Preece, F.R. S.

If has been suggested in America that steps should be taken to secure an International Conference of Electronans at the "Columbian World's Fair" "The time and place," asys the new Chicago Journal, Electrance, "are certainly suspicious, and as there are many questions in electrical science that are now awasting adjudication at would seem that it were only necessary that the invitation be made by the properly constituted bodes to have it meet with the hearty approbation of scientific men everywhere Could such a Convention be assembled it would do more than any other agency to bring together at the Columbian Exposition the most complete and varied displayed celectrical apparatise the world ever ware"

This International Agricultural Congress was opened on Monday at the Hugue by M. Millen, the President, who briefly reviewed the labours of the Paris Congress, dwelling upon its that the results obtained by that meeting would assist the avenues Governments in the legislative, administrative, and considerable of the property of the p

We have received an natimation of the sudden death, from apolexy, of Dr L Just, Professor of Botany at the Polyrechnkum, Carkvuhe, and Director of the Botanic Garden belonging to the same institution. Dr. Just was best known to the botanical world through the "Botanicker Yorksterekt, which has appeared under his name since its foundation in 1874 up to the present time, housely he resized the editorible in 1884.

MR. CHARLES JAMAGEL, well known as an unporter, breeder, and exporte of all knode of annuals, deel last Sonday at has residence in Bow. He was of German parentiage, and inherited from his father the business which be conducted with so much energy and intelligence. Many scientific collections, as well as specimens. He showed particular interest in the breeding of non-coasted Perunal greybounds, Japanese pages, and Madagascar, cais. The collection had last formed includes, the Thomas way, vogore loos, terms, and of the property of the pro

Titz number of visitors to the South Kensington Museum during the last month exceeded 120,000. This is the largest number in any one month since 1883, in which year the Fisheries Exhibition was held opposite to the Museum, on the ground formerly occupied by the Royal Horicultural Society. THE Staffordshire County Council have appointed Prof. D. E. Jones, B.Sc. (of the University College of Wales, Aberystwyth), as Director of Technical Instruction for Staffordshire.

THE Oxford Delegates responsible for the University Extension work have just published their Annual Report for the year ending July 31, 1891 No fewer than 192 courses of lectures were delivered. Of these, 90 were on historical subjects, 64 on natural science, 33 on literature and art, and 5 on political economy These figures show a small increase in the number of courses on history and literature, and evidence a marked increase in the attention that is being paid throughout the country to natural science On the other hand, political economy does not appear to be popular with those who are responsible for the arrangement of the lectures, and this circumstance the Delegates regret At several centres in the North of England the courses have been regularly attended by many hundreds of artisans, and the funds to defray the expenses of these lectures have been provided by working men societies The results of the examinations have in many cases been most satisfactory. In the opinion of Mr. York Powell "The paper classed as distinguished would have been accepted in Oxford as distinctly belonging to the honour class, the 'pass' standard is that which would be adopted in the Oxford pass school " Mr Lodge and Mr A H Johnson hear similar testimony to the efficiency and capacity of the students

Titte Timer has been printing an interesting correspondence on county museums, and we may hope that the discussion will lead to some practical results. There can be no doubt as to the need for such institutions. Properly organized, they might be of high educational valies, and they would preserve for posterity many objects of archoiological interest which are now in danger of being either destroyed or lot! The sum of the proposed measures built, however, as Tork Flower has unged, to be very clearly defined, and it would be concentrate that may be considered to be reported to be comparable to the control of the con

EVEX/ONE, interested in the scientific superts of agriculture was norry to hear that Miss Ownrool had felt in tecessary to reign her position as consulting entomologist to the Royal Agricultural Society. It is much to be regretted that understandings should have led to the severance of her connection with the Society with which she has also long been honourably associated. Fortunately her work as an entomologist is not to be interrupted, and she will continue to place her knowledge at the service of agricultursis.

THE Department of Agriculture in New South Wales is not likely to complian of lack of work. During the first three months of the Department's existence—March to May 1850—200 letters were received from farmers and others on matters of agricultural interest, during the same months of the year, 200 of the were received and fully natured. During the first tire months of the current year, over 1000 letters were written by the Department, giving specific advoc on matures, analysis of soils, because of the property of the prope

In the official statement relating to the work of the British Museum (Natural History) during 1859, reference is made to two new cases which have been placed in the central hall one of them illustrates external variation according to age, sex, and season, as exemplified in the well-known bird the Martin Charleston and the part of the case is a trended to lightwate the first of the case is a coupled by a group showing the simplest form of the case is accoupted by a group showing the simplest form of the case is accoupted by a group showing the simplest form of the remaining charlest control to a should be a successful to the case is a coupled by a group showing the simplest form of the resemblance, the general conformation of colour to shutual

surrounding. Various species of mismonals, birds, and reputies, from the Egyption desert, are arranged upon a ground consisting of the actual rocks and sand among which they were living. These specimens were collected in February 1890, and presented by Mr. F. S. Worthington. In the upper part of the case speciments are enhabled, chelly from the class of insects in which the limitation both of the form and colour of external objects is carried to various degrees of perfection and complexity. Among these is a group of Indian battlerflees [Kullham amakes], which, when at rest with their ungs closely, present a marvellous resemblance to deal leaves. Still further stages of complexity of imantion are shown in insects which closely reasonable, externally, others belonging to different families or even orders, appearately for purpose of protection.

M E. HECKEL, of Marseilles, has recently described an in teresting case of mimicry which may be frequently seen in the south of France The numic is a spider, Thomisus onustus, which is often found in the flowers of Convolvulus arvensis, where it hides itself for the purpose of snaring two Diptera, Nomioides minutissimus and Melithreplus origani, on which it feeds Convolvulus is abundant, and three principal colour variations are met with there is a white form, a pink one with deep pink spots, and a light pink form with a slight green hness on the external wall of the corolla. Each of these forms is particularly visited by one of three varieties of Thomasus The variety which visits the greenish form has a green hue, and keeps on the greener part of the corolla , that which lives in the white form is white, with a faint blue cross on the abdomen. and some blue at the end of the legs, the variety which lives in the pink form is pink itself on the prominent parts of the abdomen and legs. If the animal happens to live on Duklia resicular, the pink turns to red, and if it lives in a yellow flower-Anturhinum majus, for instance-it becomes yellow At first Prof. Heckel supposed the three varieties of Thomasus to be permanent, but he discovered accidentally that any one of these peculiarly coloured spiders, when transferred to a differ ently coloured flower, assumes the hue of the latter in the course of a few days, and when the pink, white, green, and yellow varieties are confined together in a box, they all become nearly

Ms. Theorous Baxy, according to a telegram received from him at Cape Town, has good reson to be satisfied with the results of his investigation of the Zimbabye runs. He is of opinion that the "finds" mamivakably indicate the form of worthing, the manner of decoration, and the system of gold snaclting practised by the vanished people who inhabited the buildings. He is now visiting other runs.

THE series of "One Man" photographic exhibitions at the Camera Club is to be continued during the coming water According to the Journal of the Club, there will first be an exhibition of photographs by Mr Ralph W. Robinson This will be followed by an exhibition of the work of Mr. J. P. Gibson, of Hexham.

AT a meeting of the Meteocological Society of Mauritus on July 30, it was stated that, on June 13 and 14, lait, thunderstorms occurred in that island. This, so far as was known, was the first instance of a thunder-torm having taken place snace the year 1801. There was a considerable increase of sunpois at about this time, and on June 14 a remarkable magnetic disturbance took place. Photographs of the latter part of the transit of Venus, on May 10 last, were exhibited. At sunrise the planet had already traversed about one half of its apparent path, and its apparance was perfectly round and intensely black. The time of tangential contact (at egress) was, as nearly as could be ascentianed, 81 soft m 36. A number of charts showing the winds and weather experienced by several vessels which encountered cyclones in December, Junuary, and Rebrary list were submitted; the greatest of the disturbances which had been experienced of late occurred from February 3-13. At the Observatory the barometer fell from 29 95s inches, at sh. am. on the 1st, to 29 40p inches, at sh. 5sm. am on the 6ft. Full details of these cyclones will be published by the reference to the "Allas of Cyclones Tracks," lately published by the Meteorn-logical Council, Dr. Meldrum stated that the preparation of an appendix was suffer consideration.

THE Report of the Meteorological Commission of Cape Colony for the year 1800 contains the results of observations taken at 45 principal stations, and monthly and yearly rainfall values at about 200 stations in the colony and neighbouring States. The observations are made chiefly by public officials, and by private centlemen who lend their aid. Summaries from a selected number of rainfall stations are also published monthly in the Government Gazette and in the Agricultural Journal. The expenditure for the year was only £378, so that, considering the smallness of the funds available, the results obtained are highly satisfactory, and the cost of instruments, which become the property of the observers after 5 years' continuous observations, is not inconsiderable. The Commission express the hope that their labours may lead to the discovery of the laws which govern the weather in those parts, and ultimately result in the issuing of trustworthy storm warnings. With this view simultaneous observations from various stations are telegraphed to various ports, where they are entered on sketch maps for the information of mariners and others

A CORRESPONDENT informs us that Dr. Sleich, of Berlin, has found that the subcutaneous injection of distilled water produces sufficient local anievitiesia at the point of insertion to allow small operations, such as opening a boil, to be made without pain.

THE following are some results of Herren Eister and Gettel's recent electric observations on the Sonnblick, described to the Vienna Academy -The intensity of the most refrangible solar rays, measured by their discharging effect on a negatively electrified surface of amalgamated zinc is about doubled on rising 3100 m from the lowland. The authors were unable to find other actino electrically active substances, even pure fresh snow and dry Sonnblick rock were not perceptibly discharged by light. Waterfalls may produce in a valley a negative fall of potential, and to considerable heights (500 m.) The morning maximum in fall of potential, observed regularly between 7 and 9 a m in the plain and in Alpine valleys, was absent at 3100 m. Before thunderstorms in July, the positive fall of potential sank gradually, in light showers, to mil, at which it remained sometimes two or three hours till completion of the electrical process in the cloud In thunder-clouds, or on low ground, during a thunderstorm, the atmospheric electricity usually changes sign after a discharge. St Elmo's fire (negative as often as positive) always accompanied thunderstorms. The observation that negative St Elmo's fire burns with blue flame, positive with red, was repeatedly confirmed

It is well known that the fox possesses an excellent "head for country." Referring to this subject in an interesting article in the current number of the Zoolgraf, Mr. Harting says a fox has been known to return seventy miles to his "earth," and thus not once, but three times. He was caught in Yorkshire, and sent intel, Lancashire to be hunted by the hounds of the late Mr. Fittherført Brockholes, of Claughton Hail, Garstang, and has identify was established by his having been marked in the ear by the fox-catcher This story Mr. Harting had from his fixed Captain F. H. Salvin, who was houng in Yorkshiles at the

time, and was well acquainted with Mr. Brockholes, whn gave him all the details

During the nesting season the male ostrich seems to be anything but an agreeable creature. In a paper lately read before the Royal Society of Tasmania, Mr James Andrew says that at that period the bird is most pugnacious, and may only be anproached in safety with great precaution. He resents the intrasion of any visitors on his domain, and proves a most formidable opponent. His mode of attack is by a series of Licks. The leg is thrown forwards and outwards, until the foot, armed with a most formidable nail, is high in the air, it is then brought down with terrific force, serious enough to the unhappy human being or animal struck with the flat of the foot, but much worse if the victim be caught and ripped by the toe. Instances are known of men being killed outright by a single kick, and Mr. Andrew remembers, whilst on a visit in the neighbourhood, that on a farm near Graaff Reinet a horse's back was broken by one such blow aimed at its rider. If attacked, a man should never seck safety in flight, a few yards and the bird is within striking distance, and the worst consequences may result. The alternative is to lie flat on the ground, and submit with as much resignation as possible to the inevitable and severe pummelling which it may be expected will be repeated at intervals until a means of escape presents itself, or the bird affords an opportunity of being caught by the neck, which, if tightly held and kept down, prevents much further mischief Under such circumstances, however, Mr Andrew has known a bird, with a badly-calculated kick, strike the back of its own head, scattering the biains-"a serious loss of valuable property to the former "

WE learn from the Tifts paper Caucasus that during an excursion to the sources of the Jiagdon, which was made recently by several explorers, no fewer than eight glaciers were discovered, are of which are not marked on the 5 versts to the inch from Styr khokh Pass The southern slope of the branchridge of the man chain, between the Kazbek and the Syrkhubarzon peak, has also been sketched from the Trussoff's l'ass, and it appears that several of the glaciers of this part of the chain are not represented on the great map, while perpetual snow is shown where there is none. The glaciers visited by the party proved to have very much changed then aspect since 1882. Several sulphur and non carbonate springs were visited in the frussoft's valley, and several interesting Alpine flowers in bloom were collected on the passes

A SECUL of the vegetation of British Baluchistan, with descriptions of new species, juilblished originally in the Linnean Society's Journal, has now been issued separately The author is Mr. I H Lace, who has had the advantage of Mr W. B. Hemsley's aid.

Its the Bulletins de la Nocidi d'Antirophòlogie de Paris (Iouthi excresa, val u Paris 1 and 3) the subject most prominently dealt with is the slow rate at which the population of France increases According to the report of a prolonged discussion on this question, there is much difference of opinion as to the causes to which the phenomenon must be attributed. The Bulletins also include interesting contributions on the Koubous, and antive tribe of Sumarts, by M. Zelle, a series of spoons of various spochs, by M. Capitan, the pre Columbian ethnography of Veneziels, by Dr. G. Merzano, justice in Ancient Egrpt, by M. Olivier-Beauregard; and religious evolution in the region of the Congo, by M. Clement Rubbean.

THE second part of the Catalogue of Mammalia in the Indian Museum, Calcutta, by Mr. W. L. Sciater, has just been issued. The first part was compiled by Dr Anderson, the late Super-

intendent. The total number of species included in the Catalogue amounts to 590, of which 276 are found within the Indian Empire, and 314 are exotic.

The Smthonian Institution has issued a set of well-differentian, by Leonhard Seigneger, for the use of cells ctors, who, without being herpetological experts, desire to procure for the U.S. National Muccum specimens of the repitales and batra-chanas which they may be able to guther in the neighbourhood of their residence or white travelling. The same institution of their residence or white travelling. The same institution of their residence or white travelling. The same institution of their residence of their confidence of their residence of their residence

STUDENTS will be glad to welcome the fourth edition of Prof. Mines Marshall's well-known work on "The Frog. an Intro duction to Anatomy, Hatology, and Embryology "The eather explains that the chapter on embryology has been in great part rewritten, and that some new figures have been added The entire book has been carefully revised.

THE additions to the Zoological Society's Cardens during the past week include a Dorsal Hyrat (Hyrat advirably from Sierra Loose, presented by Mr. Reginalal Brett, a Common Polecat (Mustice patient), British, presented by Mr. F. D. Lea Smith, a Ring necked Parakect (Vollectria tropystary) from India, presented by Mr. Browen, an Australian Timcknee (Editertrial Augustian) from Austrials, pre-sented by Mr. Perkinand von British, presented by Mr. British, pre

OUR ASTRONOMICAL COLUMN

SOLAR OBSERVATIONS—In Compter surder for August 2s. Frof Teaching gives a risum of the volar observations made at the Observatory of the Roman College during the second quarter of this year Spots and facult lave been observed on 73 days, viz 25 in April, 23 in May, and 25 in June, The following are the results obtained—

	Relativ	e frequency	Relative :	Number	
1891	of spot-	of days without spots	of spots	of facula	per day
April	9'24	0 00	24 56	55 60	2 36
May	14 35	0 00	48 14	51 82	4 00
June	16 88	0 00	47'00	89 38	3 80

The distribution and magnitude of the prominences observed are as follow ---

1891	Number of days of	Mean number	Mean height	Mean extension	
April	observation 18	7'50	42 3	ı°5	
May	21	4 62	37 3	14	
Turne					

It is worthy of remark that there was a secondary maximum in May in the case of spots, whilst a secondary minimum is indicated by the observations of prominences

indicated by the observations of prominences.

CONNECTION ENTERNER TERRESTRIAL MAGNETISM AND RADIANT SUMLIGHT.—Frof. Frank II. Higglow contributes a note to the description of the property of the contributed of the carbon may be principally due to the contribute of the earth may be principally due to the contribute of the earth may be principally due to the orbital anotion of the earth may be principally due to the orbital anotion of the earth from the first of the contributed of the carbon may be contributed on the axis of point and the contributed of the contributed on the contributed of the c

NO. 1141, VOL. 44]

This miteresting identification of the magnetic and light action of solar radiations is in harmony with the results of the investigation of the property of th

Two New Astakoins -On August 28, Charlos discovered the 313th minor planet, and Pallsa found the 314th two days

PHYSICS AT THE BRITISH ASSOCIATION

THIS Section, as is infortunately the custom, was housed in an acclessizated edifice in which no provision had been mide for the exhibition of apparatix or lantern slides by the moite for the exhibition of apparatix or lantern slides by the realises of spages. We doubt, it is impossible always to provide control of the property of the property of the possible to provide anticle of the Section Still, it should be possible to provide aincin and verse, and provision should be untell, when goarantee that lantern sides could always be exhibited, many cales of apparet would avail themselves of the opportunity to illustrate their communications much more adequacylythan is possible at present, when the only applicates are a preceded that the communications much more adequacylythan to possible at present, when the only applicates are a preceded that beautiful photographs of Mr. Claytia and the Copeland had to be passed round from hand to lind mixed of being cobabited in a manner which would have done justice to their ments. I be contents of many of the pages, too, would be much more easily

a manner which would have indee justice to their nexts. I he want pleasantly graped if such a course were adopted. Unfortunately, some of the leading physicists, notably fix william Thomoson, Lord Raypigs, and Frof Frigarenil, were the charge in the control of the leading physicists, notably fix the control of the course o

After the President's address on Thursday mining, Prof. Newton commissated a most interesting account of the action of Jupiter on small boths, passing near the planet, in which he quivalent the professional profes

Mr. W. E. Wilson resit a paper on the absorption of heat un the solar amougher, and exhalted some of the apparatus he had used in the investigation. The unfool of observation he had used in the investigation. The unfool of observation acrows the thermo-electric junction of a floys radio-incrementer. He finds that the solar radiation from the extreme period of the dark of attained, by the standard period of the dark of attained period in the extreme period of the dark of attained period in the entirely from that of the moon, in which there is little or no exhibit period of different parts of the varieties of the varieties.

face. This difference is attributable to the absorption of heat in the solar atmosphere, which will necessarily be much more marked for the peripheral than for the central portions of the

Mr. G. H. Bryan presented an elaborate report on researches relative to the second law of thermodynamics, in which is described an exceedingly simple mechanical representation of Carnot's reversible cycle.

Friday was devoted to papers on electrical aubjects. Prof. Friday was devoice to paper on electrical ampiects. Prof. Andrew Gray read a paper on the electro-magnetic theory of the rotation of the plane of polarized light. Sir William Thomson's explanation of the phenomenon rests on the supposition that the ether has embedded in it a large number of small gyrosita. Prof. Gray showed that the ordinary Maxwellian equations for the phenomenon were obtainable on the supposition of the existence of a closed chain of small magnets embedded in the undisturbed medium, which set themselves with their axes to the

undistursed medium, which set themselves with their axes is the direction of propagation of the ray as soon as the medium was magacitzed in that direction.

This paper was followed by a most interesting communication from the President, in which he gave as account of preliminary experiments to accretant fit the other is disturbed in the neighbourhood of a rapidly moving body—in other words, to accertain whether the ether behaves as a viscous fluid. Allusion was first of all made to the experiments of Arago, in which he endeavoured to determine whether or not the ether was stagment with respect to the earth by measuring the refractive index of a (if it exist) will flow in one direction or the opposite through the prism Arago found no such shift, indicating that the ether was stagnant with reference to the carth Fresnel, Fizeau, and Michelson had also studied theoretically or experimentally the ratto of so called "bound" ether to "free" ether The problem which Prof Lodge set himself to determine was whether a disk moving with great rapidity would or would not drag after it the other in its immediate neighbourhood. Two parallel co-axial disks of steel were arranged to spin at an enormous rate Rays of light from a single source were allowed enormous rate. Rays of fight from a single source which half the to fall on a glass plate feelily silvered so that about half the light was transmitted and half reflected. By means of additional reflectors the two beams passed in opposite directions several times round in the space between the two disks, and were then observed in a common telescope and made to give interference bands. In this way, assuming viscosity of the other, the one beam would have its velocity increased, the other would have its velocity retarded, with the result that a shift of the interference bands would be produced So far, however, no such shift has been observed

beas observed Prof. D. E. Jones gave an account of some experiments made by him at Bonn on electric waves in wires. Measure ments of the electrical disturbance at different points of a wire, in which stationary waves are set up, were made quantitatively by patting a thermo-electric pattorion in the circuit at different points are supported by the pattern of the pa explanations were forthcoming
A communication was read from Lord Rayleigh, relating to

the reflection of polarized light from liquid surfaces. He finds the renection of polarized light from liquid surfaces. It is note that the light reflected at the polarizing single, from clean liquid surfaces, is only very slightly elliptically polarized, if, however, the surface be ever so slightly contaminated, the amount of elliptically polarized light in the reflected beam is enormously

increased.

Saturday was devoted principally to the consideration of papers on electrolysis. Mr. Shaw's report on the present state of our knowledge in electrolysis and electro-chemistry included a tabular compilation by Mr. Fitzpatrick of the electrical properties of soluble sails at different temperatures, and for different concentrations.

Mr. J Brown read a paper on Clausius's theory of electro-lytic conduction, and on some recent evidence for the dissocia-tion theory of electrolysis, in which he gave an account of experiments with so-called semi permicable membranes. The explanation of their filtering qualities simply depends on the membrane acting as a conductor

memorate acting as a continuous Mr Chattock gave an account of some important quantitative experiments which he had made on the discharge of electricity from points from which he finds that it is the air round the point rather than the metal surface itself which offers resistance to the

rainer inan ine inerai suince each adacharge.

On Ignday the meteorological and allied subjects were taken. The Rubes of various Committees appointed to deal with meteorological subjects were read.

Dr Johnstone Stoney read an interesting paper on the cause of double fines in the spectra of gases. He assumes that the

and he illustrated the simple case of sodium vapour by means of a pendulum oscillating to and fro, but with an apsidal motion.

He stated that the application of astronomical methods of calculation to molecular motions of sodium vapour gives rise to a double D line instead of to a broadening of the line as might at first sight he imagined. In the discussion which followed, Mr. Webster stated that Frof Michelsoa, who was endeavouring to determine the metre in terms of the wave-length of light emitted by a vibrating atom, had found by the interference method that all the mercury lines are the in double.

Dr. Copeland exhibited a model to explain the probable ture of the bright streaks on the moon. He attributes the nature of the bright streaks on the moon. He attributes the appearance of the streaks to the existence of transparent spheres on the moon's surface, which reflect the light from the posterior surface so as to be only visible in the line of light

During the morning the President interpolated some observa-tions dealing with the effect of light in modifying the effect of the gravitational attraction of the sun on small particles. When the gravitational attraction of the sun on small particles. When sunlight falls upon a body, a very small repulsave effect sproduced, amounting to about 67 dynes per square meter. Thus, for example, during an eclipse of the moon about 1000 tons are suddenly applied, but this small force is incapable of producing any observable effect on the motion of our astellite. The smaller the body, the larger, of course, the surface exposed relatively to the mass, and therefore the greater should be the effect produced For a certain size of particle (about that of a grana of dust) the gravitational attraction and light repulsion should balance one another The effect is clearly independent of distance

of distance. "Da Tuesday, after the Report of the Committee on Electrical Standards, read by Prof. Carey-Footer, and an account of an action of Clark collish there was armonged a point discussion with Section of Clark colls, there was armonged a point discussion with Section 65, on "Units and their Nomenclature," which was opened by the President, who suggested that the discussion should, as far as possible, be confined to electrical units, and that the mechanical units should be left to a later period. He discussed at some length the relative advantages and disadvan-tages of the various names for the unit of self-induction, secohm, quadrant, heary, &c, and expressed himself as of opinion that the quadrant, which was really an angular measure, but which was frequently used as a linear measure, was very objectionable in that it indicated that the uait of self-induction was a length, in that it indicated that the uall of sein-induction was a length. He was, therefore, of opinion that some aame with a less obvious meaning, such as that of a person, was very desirable. He thought also that the secohm was too large for practical purposes, and that some sub-multiple such as 1958 would be preferable

The President was followed by Mr. Procee, who referred to the work of the British Association Committee on Electrical Standards, which had lasted now for thirty years, and expressed the opinion that it would be undesirable to interfere in an with the old standards now about to be legalized by the Board

of Trade

Prof Stroud read a paper on some revolutionary suggestions on the nomenclature of electrical and mechanical units, in which he advocated selecting 100 cm, as the unit of length, 10-9 gm. as the unit of mass, and I see as the unit of time to form the basis of a new practical system of units. He also explained the details of a system of automatic nomenclature for C.G.S. and other units, which he thought should be taken into consideration before any fresh names were authorized. The special feature of the system is that every label is self-explanatory.

the system is that every label is self-explanatory.

Dr Johnstone Stoney thought the old system should remain intact, and that the proper way to deal with the subject of nomenclature was to indicate sub-multiples by numerical prefixes, e.g. he would call a microfand a sixth farad, and the capacity of a Leyden jar would be about a tenth farad. Gilbert, and that of the unit of magnetism should be a Gilbert, and that of the unit magnetic field a Gauss.

Prof. Carey Foster thought that if the volt and ampere were

made ten times as great, fresh names, such e.g. as "gal, from Galvani, should be introduced.

rous oursain, should be introduced. Prof Rucker laid stress on the importance of recognizing the fact that we possessed at present no definite knowledge as to the absolute dimensions of any electrical or magnetic unit, and therefore it was undesirable to introduce names and the stress of the property of the property

knowledge
Prof S P Thompson drew attention to the desirability of

distinguishing between scalar and vector quantities in our di-

Prof. Grav disapproved of the term electromotive for thought it was a term which could scarcely be eradicated now Each speaker, in fact, discussed the subject from his own point of view, with the result, as the President remarked, that the time allotted had only served to open the discussion, but he hoped that it would be continued in the technical journals during the year, so that some definite conclusions might be arrived at in

1892. Wednesday morning was devoted to clearing off arrears. Wednesday morning was devoted to clearing off arream. Prof. S. P. Thompson read two optical papers, one on the measurement of lenses, and a second on a new polarizer. In this instrument the polarization is effected by reflection from prime is used in addition. This arrangement has the dis-advantage that the axis of the beam undergoes a translational shift, so that rotation of the polarizer is out of the question. In get over this difficult two more reflection are introduced, or we quarter wave plates may be used, one of which converts the plane polarized light into creatingly polarized light, while the

plané polarazed light into circularly polarazed light, white the other reconverts into light plane polarazed in any armitto on a new method for determining v. The method is aimitted in the present to Aprico and Perry's, and gave as a result in the pre-liminary experiments 2 9/9 × 10¹⁰. For the present to a profession of the professi eeptible at considerable distances

Prof J V. Jones, in describing some experiments on the periodic time of tuning forks, maintained in vibration electrically, stated that dry platinum platinum contacts do not work satisstated that ary putanum pitanum contacts on not work satisfactorily, whereas the results obtained with mercury contacts are much better, at all events when changes of temperature are carefully guarded against.

Mr. F T Trouton described some interesting experiments to

determine the rate of propagation of magnetization in iron A large coil of iron wire, from 8 to 12 feet in diameter, was large coil of iron wire, from 8 to 12 beet in diameter, was supplied with one fixed coil wound on it, and through which the alternating current passed. A second exploring coil was connected up with a telephone, and one experiment consisted in endeavouring to find out the positions of nodes and inter-nodes in the magnetized material from which it might have been possible to have determined the length of the wave of magnetization for a definite period of alternation. Nodes were observed in the half of the ring remote from the magnetizing coil, but these were easily ascertained not to be the ones sought for, because their position was not found to depend on the period of alterna-

The President attributed the effects to mechanical vibrations excited by magnetization,

CHEMISTRY AT THE BRITISH ASSOCIATION.

THE proceedings of Section B at Cardiff were not felt to be as interesting as on some previous occasions. Several wellas interesting as on some previous occasions. Several well-known chemists were not present, and no set discussions on subjects of general chemical interest, which have been special features at other times, took place. Still, in the conres of the meeting several papers of very considerable importance were read, and provoked valuable comments. The Fresteden's Ad-dress was listened to by an enhustrastic audience, and his remarks, together with several of the papers contributed during the meet-

together with several of the papers contributed during the mestga, should give a fresh imputs to the study of the mestals the
Fred. Demann read the Report of the Committee on
Fred. Demann read the Report of the Committee on
the choicine, preparted by the senson of hydrogen chloride
on manganese droude, attacks mercury readily, even when both
substances are presented by white line obstanced by heating
the substances are presented by the senson of hydrogen chloride
and the substances of the senson of hydrogen chloride
cidentally it has been discovered that pure platinose chloride is
very difficult to butance to prepare, an oxychloride being formed

at the same time. The results so far obtained are to be revarded as preliminary.

Prof Vivian B Lewes read a paper on the spontaneous ignition of coal. His experiments lead him to reject the explanation of Berzelius, which attributes spontaneous ignition to the oxidation of pyrites contained in the coal The heat given off by the combustion of the pyrites present in the most dangerous kind of coal, even if localized, would not be sufficient to raise kind of coal, even it localized, would not be sumcient to raise the temperature of the adjacent coal to the signition point. The cause of apontaneous signition of coal is to be found, rather, In its power, especially when finely divided, of absorbing oxygen, which causes the slow combustion of some of the hydrocarbon constituents even at the ordinary temperature. The action may increase under favourable conditions until ignition of the coal result. The risk is greatest with large masses of coal, and with results. The risk is greatest with large masses of coal, and with the oritinary art supply on board ships. The excitation increases rapidly with the initial temperature of the coal, so that call first are found to occur most often on ships frequenting tropical climates. It may be roughly estimated that the absorbing power of a coal for oxygen is proportional to its power of taking up

mosture In the discussion which followed, Prof Bedson mentioned his experiments on the heating of coal-dust at various temperatures up to 140° C. He had noticed that in some cases com-

bustible gases were given off by the coal

A feature of special interest was the exhibition by Ludwig Mond of specimens of nickel-carbon oxide and metallic nickel obtained therefrom In the paper read in conjunction with obtained therefrom. In the paper read in conjunction with metable an account was given of the discovery and properties of the above compound. The physical properties of the above compound. The physical properties of the above compounds the physical properties. Chemically, include carbony is most inactive, namesous experiments made to introduce the evrhonyl group into organic control properties. The physical properties of t or sulphur, the process is entirely successful on a laboratory scale Such ore, or matte, or speiss, is calcined, reduced by water gas at 450°, cooled down to a suitable temperature, and treated with earbon monoxide in a suitable apparatus. On exproving a heated surface to the gas containing nickel earbon-oxide, it is possible to produce, direct from such gas, articles of solid nickel, or goods plated with nickel, resembling in every way those obtained by galvanic deposition of metals, and repro-ducing with the same exactitude and fineness any design upon such articles This result can also be obtained by immersing heated articles in a solution of nickel carbon oxide in such solvents as henzole, petroleum, tar oils, &c , or by applying such solution to the heated articles with a brush or otherwise

A specimen of iron-carbon-oxide was exhibited, which Messes. A specimen of iron-carton-oxide was exhibited, which Meist-Mond and Langer have obtained as an ambet coloured liquid, which, on standing, deposits tabular crystals of a darker colour, and solidines entirely below - 21° Ct on amass of needleshiped crystals. It boils at ro2° C, but leaves a small quantity of green-coloured oil behind Several analyses and vapouried with the part of the colour o

whither a pure substance has been obtained or a mixture of several tron carbonyls. The authors hope aboutly to publish a full account of this interesting substance, which difficult in the substance of the subst induction coil at ordinary temperature, and if a piece of glass be placed underneath the gold in the tube, on passing the current placed undermeath the gold in the tube, on passing the current an entaillic mirror appears on the glass, increasing in thickness to a leaf, which can be peeled off, and which is perfectly homo-geneous. Films of silver and platinum can also be obtained it is found that different metals thus treated evaporate at different it is communate direction means thus treated evaporate at directinates, one or two, such as aluminum and magnosimi, heing apparently non-volatile. It is thus possible, in the case of the administrative of alloy discovered by Prof. Roberts-Austen, to separate a large portion of the gold from the aluminum by clearing a portion of the gold from the aluminum by clearing a portion of the gold from the aluminum by the central evaporation.

T Turage gave an account of experiments which he had made to discover the cause of the red blotches which often appear on the surface of brass sheets on rolling, and which are a great source of annoyance to Birmingham manufacturers. They are

due to the erosion of the zine by the chlorides present in the solution in which the brass has been pickled, and in the water

solution in which the brass has been pickled, and in the water in which it is afterwards washed, care not being always taken to prevent such chlorides from drying on before rolling.

A P Laurie described the experiments he has made to determine the electromotive forces of various alloys with a view to establishing the existence of definite compounds among them. His earlier experiments will be found in the Journ. Chem. Soc., 1888, p 104. His recent work leads him to conclude that a compound of gold and tin of the formula AuSn exists, a sudden rise of electromotive force being observed when the proportion of tin in the alloy exceeds that required by the above formula.

of in in the alloy exceeds that required by the above formula. Compounds do not appear to exist among the alloys of unc, cadmium, lead, and tin Prof. Roberts-Austen exhibited and described his self-recording pyrometer. In this instrument, thermal junctions of platinum and platinum containing to per cent of rhodium are connected with a galvanometer The spot of light from the mirror of this. I caused to fall on a with before which a photographic plate passes at a given rate, by which means a curve is traced, corresponding to the variations in temperature of the heated thermal junction. The other junction is kept at a con-stant temperature by immersion in water. Temperatures up stant temperature by immersion in water. Temperatures up to the melting-point of platimum can be determined with an occuracy of 10°. The curves of cooling of several alloys have been determined. The alloy of gold and aluminum differs from others, such as that of platinum and lead, in that there is no break in the curves at the point of shalifaction of the alloys. entitled. "The Relation between the Composition of a Double-Salt and the Composition and Temperature of the Lanout on

Salt and the Composition and Temperature of the Liquid in which it is formed." The authors have obtained a large number which it is formed. The authors have obtained a large number of double chlorides of ammonium and ron by crystallizing from solutions containing varying amounts of ferrous and ammonium chlorides, and maintained it different temperatures. The convention of the contract of may exist in other cases

Prof Dunstan, in the discussion which followed, described a series of double cyanides of zinc and mercury, of complex composition, which he had obtained by precipitation

composition, which he had obtained by precipitation In a preliminary account of some experiments he is making on the action of oxide of cobalt in causing the evolution of oxygen from hypochlorites, Prof. M'Leod showed that, on boiling an alkaline solution of a hypochloric alone, some oxygen is evolved and chlorate formed, so that the action is probably

gen is evolved and chlorate formed, so that the action is probably somewhat complex in presence of oxide of collective year. He Report on the Isomeric Naphthalene Derivatives. The study of the dichloransphthalenes has been completed. Of the twefve reported to exist, only ten could be obtained. This number is that required by theory. Of the fourteen theoretically possible trichloronaphthalenes, thirteen have been obtained. The compound containing the chlorine atoms in the positions I 2 I' is missing These results put it beyond question that naphthalene has a symmetrical structure. Its exact inner configuration has mas a symmetrical structure. Its exact inner configuration has yet to be dealt with. Experiments have been made with a vitte to determine the inanner in which substitution takes place. It appears probable that an addition product is always first formed.

Prof. Rucker gave an account of the experiments made by Prof. Rucker gave an account of the experiments made by Prof. Ruckers Austen and humself to determine the specific heat of the self-recording pyrometers above ment model and the self-recording pyrometers and the special fless in recrease regularly up to the melting-point, which is not very definite. About the point there is considerable aboptions of literath feat. The mean specific heat physicars and apply was found the way and between 25% and 1907, 332 Prof. Pt. Clowes described an apparatus for testing asfert-limits and the self-recording and the self-recordi

paraffin, in which the mixture of fire-damp and air could be made, the safety-lamp being afterwards introduced. A lamp

was exhibited which would indicate in this apparatus '25 per

was exhibited which would indicate in this apparatus. 2) jet-ent of fire-dampingoo described the results he has obtained on repeating the experiments of Kruss and his colleagues on the sare earths, which caused them to announce the probable exist-ence of about twenty new elements. Although he has worked on material from the same locality and of the same appearance as that used by the above-named workers, he has entirely failed to confirm their results, at any rate with regard to the didymlum fraction. He considers that the absence of certain lines noticed by them in the didymum spectrum may be due simply to dilu-tion, and do not indicate a splitting up of that element. On making his solutions sufficiently strong, he was able in all cases

to obtain the lines

Prof. Ramsay drew attention to the remarkable properties Prof. Ramsay drew attention to the remarkable properties which are exhibited by the hquids obtained by passing excess of hydrogen sulphide into solutions of certain metals, and afterwards expelling the excess of hydrogen sulphode by hydrogen Mercures sulphide treated in this way dissolves to a dark-brown solution. Artimony and assemic sulphides also dissolve. On examining the mercury solution under the microscope, brown examining the mercury solution under the microscope, bown particles are seen in a state of rapid motion. With natimony solution, particles are not vauble, but a sort of granular movements of the state of the state

a state of mpod but erecum-eribed motion.

One of the few papers on organic chemistry was reach by J. J.

One of the few papers on organic chemistry was reach by J. J.

Chemistry of the composition of th lene is chlomated, and forms the dichloride C₁H₂Cl₁, proper properties practically unacted upon, anylene forms a nursoo oppose to practically unacted upon, anylene forms a nursoo smaler compound, C₁H₂NOCI, melting it gr². Crotonic said a unacted upon, even when heated to go², while obecaused results from definite autro-ord-horder, the former melting acute resulty form definite autro-ord-horder, the former melting when cooled, but forms the dichloride C₁H₂O_CCl₂ when heated to 100° Up to the present the author can find no have regulating the action of nursoy blonder on various carbon

compounds.

A paper was read by C G Moor, on a new method for the disposal of sewage This consists in the application of a method disposas of sewage — int consists in the application or a memor-invented by Mr. Rees Rece for obtaining far ammona, &c.-A kind of Inne-kin is employed, with a forced draught, con-nected to a sense of condenser. The operation is conducted in such a manner that the material in the lower part of the furnace is kept in active combistion, it is head distill the material directly swep, an active community, in their think to serve as fuel for the succeeding charge. Eighty per cent. of the theoretical yield of ammonia has been obtained. In order for the process to be commercially successful, it seems that the use of lime in ressing the sludge should be avoided at all costs, as, if much

to be commercially used creams an accurate many measures are made in the case of the case

SOME DIFFICULTIES IN THE LIFE OF AOUATIC INSECTS

M/E understand insects to be animals of small size, furnished WE understand insects to be animals of small size, furnished with a hard kin and six legs, breathing by branched artubes, and commonly provided in the adult condition with wings. The animals thus organized are pre-emisently a dominant group, as is shown by the vast number of the species and inclinicalist, their universal distribution, and their various

The insect type, like some fruitful inventions of manor lithography, for instance—has proved so successful that it has been found profitable to adapt it to countless distinct purposes

I propose to consider one only of its infinitely varied adapta-

tions, viz its adaptation to aquatic life.

There are insects which run upon the earth, insects which fly in the air, and insects which swim in the water. The same might be said of three other classes of animals—the three highest—viz mammals, birds, and reptiles but insects out insects of all other classes of animals in the variety of their modes of exist-But insects surpass Owing to their small size and hard skin, they can burrow into the earth, into the wood of trees, or into the bodies of other There are some insects which can live in the water, animals are the some insects which can be a first and the mammal, bird, or reptile does, coming up from time to time to breathe, but constantly immersed, like a fish. This is the more remarkable because insects arc, as a class, and breathers. Air tubes or trachese, branching tubes, whose walls are stiffened by spiral threads, supply all the tissues of the body with air That such an animal should be hatched in water, and wild air. I flat such at stiller insurersed, a thing which actually happens to many insects, is n matter for surprise, and implies many modifications of structure, affecting all parts of the

body

The adaptation of insects to aquatic conditions seems to have The adaptation of insects to aquatic conditions seems to have been brought about at different times, and for a variety of dis-tanct purposes. Many Dipteron larva burrow in the eastli-Some of these request the damp earth in the neighbourhood of streams, others are found in earth so sorked with water that it might almost be called mud, though they breath by occasionally taking in atmospheric air. In yet more specialized members of the same order we find that the larva inhabits the mud at the the same order we find that the larva inhabits the mud at the bottom of the stream, and depends for its re-paration entirely upon oxygen dissolved in the water. The motive is usually that the larva may get access to the decaying vegetable inatter found in slow streams, but so ne of these larvae have carmivorous propensitles Other insects merely dive into the water, coming up from

Other insects mertly dive into the water, coming up from time to time to breath, or a skate upon the surface Nearly every order of insects contains aquatic forms, and the total number of such forms is very large I believe that all are modifications of terrestrial types, and it is probable that members of different liamilies have often betaken themselves to

The difficulties which aquatic insects have to encounter begin with the egg It is in most cases convenient that the egg should while the laid in water, though this is not indispensable, and the winged, air-breathing fly is, as a rule, ill fitted for entering water. Some insect eggs hatch if they are merely scattered, like grains of sand, over the hottom of a stream, but others must be laid at the surface of the water, where they can gain a sufficient supply of oxygen. If the water is stagnant, it will suffice if the eggs are buoyant, like those which compose the egg-raft of the gnat, but this plan would hardly answer in running streams, which would carry light, floating eggs to great distances, or even sweep them out to sea. Moreover, floating eggs to great distances, or even sweep them out to sea. Moreover, floating eggs are exposed to the attacks of hungry creatures of various kinds, such as burds or predatory musect larve. These difficulties have been met in the cases of a number of insects by laying the eggs in chains or strings, and mooring them at the surface of eggs in chans or strings, and mooring them at the surface of the water. The eggs are invested by a gelations envelope, which swells only, the moment it reaches the water, into an the surface of the surface of the surface of the surface than one purpose. In the first place it makes the eggs no allphery that birds or insects cannot grasp them. It also spaces to be eggs, and enables each to get it six share of arr and sim-light. The gelatinous substance appears to possess some anti-gible property, which presents water-models from attacking the

¹ Evening Discourse, delivered before the British Association, Cardiff, 1891, by L. C. Miall, Professor of Biology in the Yurkshire College

eggs, for, long after the eggs may mission of the frog, which are lead in the staguant water of ditches or ponds, float free at the laid in the staguant water of ditches or ponds, float free at the surface, and do not require to be moored vanile are laid in the form of an adhesive band, which holds are laid in the form of an adhesive band, which holds are laid in the form of an anyatte plant. Some insects, eggs, for, long after the eggs have hatched out, the transparent shall are laid in the form of an adhesive band, which notes firmly to the stem or leaf of an aquatic plant. Some insects, too, lay their eggs in the form of an adhesive band. In other cases the egg-chain is moored to the bank by a slender cord.

The common two-winged fly, Chiionomis, lays its cggs in trus-parent cylindrical ropes, which flost on the surface of the water During the summer months these egg ropes, which are nearly an inch in length, may readily be found on the edges of nearly an men in length, may readily be found on the edges of a stone foundation in a garden, or in a water trough by the side of the road. The eggs are arranged upon the outside of the rope in loops, which bend to right and left alternately, forming simous lines upon the surface. Each egg rope is moored to the bank by a thread, which passes through the middle of the rope in a series of loops, and then returns in as many reversed and an a sense of hosps, and then teturus in as; many recvered and ornelapping loops, so as to give the apprenance of a tools-witch ornelapping loops, so as to give the apprenance of a tools-witch accedie subnout breaking. If the egr reige is dispect into beal wine they are in solide, owing to their transparency. The subnout of the subnou signal shape when released By mean, of these threads, original shape when released. By mean, of these threads, feruly intervoven with the muchage, of the egg rope, the whole mass of many hundreds of eggs is firmly moored, yet so moored that it floats without strain, and rises or falls with the stream. The eggs get all the sun and air which they require, and neither predatory insects, nor birds, nor water moulds, nor rushing currents of water, can injure them

The eggs of the caddis fly are laid in larger ropes, which, in some species, are very beautiful objects, owing to the gras-green colour of the eggs. The egg raft of the gnat, which has often been described, is well suited to flotation in stagnant often been described, is well suited to flotation in streams where, and is field very expect of the air, a point of unusual im-portance in the case of an insect which in all stages of growth scens to meel the most efficient means of respiration, and whose ggg are assally laid in water of very doubtful purity. The lower or submerged end of each egg opens by a lid, and through this opening the laws at length is super-

this opening the larve at length excapes. The eggs of water haunting insects are in many ways particululy well suited for the study of development. The eggs of chronomus, for instance, can always he protucted during the summer mouths. They are so transparent as to admit of exammation under high powers of the microscope as living objects, and as they require no sort of preparation, they may be replaced in the water after each examination to continue their develop me nt This saves all trouble in determining the succession of must This saves all trouble in determining the succession of the different stage—a point which awailly presents difficulties to the embryologist. The whole development of the egg of Chronomaus is completed in a few days (there to us, according to temperature), and in it therefore an easy matter to follow the present thoughout with the help of three or four chains of eggs. When the larve are hatched, and escape into the water, new ficulties arise Some have to seek their food at the surface difficulties arise of the water, and must yet be always immersed, others live upon food which is only to be found in rapid streams, and these run enous risk of being swept away by the rush of water All need selious risk of being weigt away by the reach of water. All need at least a moderate supply of coygen, which has either to be drawn from the air at the surface, or extinated from the water by special organ. The difficulty of breathing r, of course, greatly mneeased when the larva seeks its field at the bottom of fool attenues, as is the case with cottain Diptira. The larva of Chronomus, for example, feeds upon vegetable matter, often in a state of decay, which is obtained from the mult at the bottom of slow streams, and in this mud the larva makes burrows for of slow streams, and in this mid the larva makes burrows for tuelf, cementing together all vorts of materials by the secretion of its anivary glands, drawn out into fine vilken threads. The burrows in which the larva lives furnish an important defence against fishes and other enemies, but they still curther increasagainst resides and other enemies, but they still further increas-ine difficulty of procuring a supply of air Hence, the farva frequently quits its burrow, especially by night, and swims towards the surface. At these times it loops its body to and fro with a kind of Isshing movement, and is thus enabled to advance and first in the water. From the well-serated water at the surface of the stream it procures a free supply of oxygen.

which becomes dissolved in the abundant blood of the larva which becomes dissolved in the abundant blood of the larva Four delicate tabes filled with blood, which are carried upon the last segment of the body, are believed to be especially insteaded for the taking up of dissolved oxygen. The Irachesi system is radimensary and completely closed, and hence gastons in radimensary and completely closed, and hence gastons which have been completely closed, and hence gastons with the body of the larva, and used with the greavest conomy. It is apparently for this reason that the larva of Chronomus contains a blood-red pigment, which is identical with the hancefullowing of which the present contains a blood-red pigment, which is identical to the contained of t acts in the Chironomus larva as it does in our own bodies, as an oxygen carrier, readily taking up dissolved oxygen, and parting with it gradually to the tissues of the body.

It is instructive to notice that only such Chironomus larve as live at the bottom and hurrow in the mud possess the red hæmoglobin Those which live at or near the surface have hemoglobin Those which live at or nest the surface have colourless blood, and a more complete, though still closed, tra cheal system The larva of the carnivorous Tanypus, which is colourness bloom, and a more complete, mongh duri chooled, the most complete than a more than the control to th ably statisfactory reason for the occurrence of hemogloban in a number of animals whose reprinciply variases in limited, and whose are reprinciply and the state of the state of the state whose are reprinciply and the state of the state of the state whose are reprinciply and the state of the state of the state animals under the same conditions manage perfectly well without hemogloban. Such admission is not a logical relutation of the explanation in might fairly put forward the baldness of man-riciple and the state of the state of the state of the explanation would not be ampured by any more wife, and that explanation would not were way. The facts its that the respiratory needs, even of closely alled animals, vary greatly, and further, there are more ways than one of acquiring and storing up oxygen in their bodies.

Either the storage-capacity for oxygen of the Chironomus Either the storage-capacity for oxygen of the Chronomas larva is considerable, or it must be used very carefully, for the larva is considerable, or it must be used very carefully, for the of dutilled water, boiled it for three-quarters of an hour, closed it tught with an indisrubber bung, and left it to cool. Then six larva were introduced, the small space above the water was replaced, and the larva were watched from day to day. Four of the larva surrived for forty eight hours, and one till the fifth day. Two of them changed to pupe. Nevertheless, the water was from the first exhausted of oxygen, or nearly so

The Chironomus larva is provided with implements suited to its mode of life The head, which is extremely small and hard. carries a pair of stout jaws, besides a most complicated array of hooks, some fixed, some movable The use of these minute hooks, some fixed, some movable. The use of these mands appendages cannot always be assigned, but some of them are apparedly employed to guide the sulky threads which issue apparedly employed to guide the sulky threads which issue for a first or the superior appared to those progression and help the larva to These are mainly used in progression, and help the larva to think tiself to and fro in its burrow. A smaller, but longer pair of hooked feet is found at the end of the body. This hander pair serves to a glaste, the animal to its burrow when it atteches forth in search of food

both in search of food

Creeping aquatic larve, such as Ephydra, possess several pairs

of legs in front of the last pair, but the burrowing species, such

as caddia-works, agree with Chronoms, not only in their mode

of life, but also in the reduction of the abdominal legs to a single

pur, which are compensoraly hooking of their pairs of the pairs

for the last of the last of the last of the pairs of the pairs

for the last of the l

little more than an implement for biting and spinning, by no

means such a seat of intelligence as it is in higher animals. In Chironomus it contains no brain, the eyes are mere specks of pigment, and the antenne are inagmicant. But the head of pigment, and the antennee are insignificant. But the head of the flu nedoese the brans, and beare slaborate organs of special sense—many facetted eyes, and in the mule beautiful plumed sense—many facetted eyes, and in the mule beautiful plumed replants the fact that the bead of the flux not developed within the larval head, but in the thorax. It is only at the time of papation that it becomes everted, and it as pipendage assume the position which they are ultimately intended to occupy. At length the Chromosous wangels could for the result skin, and

is transformed into a pupa. It no longer requires to feed, and the mouth is completely closed. It is equally unable to burrow, and usually lies on the surface of the mud. Two tufts of silvery and usually lies on the surface of the mud. I wo ture of slivery respiratory filaments project from the fore-end of the body just behind the future head, and these wave to and from the water. as the animal alternately flexes and extends its body. At the iail end are two flaps, fringed with stout bristles, which form a iail end are two flaps, fringed with stout braitles, which form a kind of fan. The pupa virtually consists of the body of the fly, inclosed within a transparent kin. The organs of the fly are very closely resemble those of the perfect animal. These parts are, however, as yet very imperfectly displayed. The wings and legs are folded up along the sides of the body, and are and legs are folded up along the sides of the body, and are ineapable of independent movement. For two or three days ally had the blood-red colour of the larva, gradially assumes a darker tint. The tracked system, which was quite rudimentary in the larva, but is now greatly enlarged, becomes filled with an accessed from the star by the help of the respiratory tiths, are secreted from the star by the help of the respiratory tiths, splits, the fly extractes its limbs and other appendages, pause of a moment upon the floating purps.ceas, as if to fyr its wings, and then flies away.

This fly is a common object on our window panes, and would the first of Chronomus associate in swears, which are believed in the first of Chronomus associate in several ways. in this case to consist entirely of males. The male fly has plumed antenne with dilated basal loints. In the female fly the antennse are smaller and simpler, as well as more widely

segarated and herely stream another Dipterous have may often. In head and herely stream another Dipterous have may often the head of Simulium, known in the winged state as the smod-fly. The Simulium larve much smaller than that of Chinomonia, and its blood is not tinged with red. The head is provided with a pair of ciliary and here upon a sort of stem. The finged filaments are used to sweep the food into the mouth. The larve of Simulium subsums starticy upon microcopop plants and anomain. Among subsiss entirely upon microscopic plants and animals
these are great numbers of Diatoms, and the stomach is usually
found half full of the finity valves of these microscopic plants.
The Simulium larva seeks its food in rapid currents of water,
and a brisk flow of well-acrated water has apparently become a necessity to it. If the larve are taken out of a stream and placed in a vessel of clear water, they soon become sluggish, and in warm weather do not survive very long. It matters little, however, to the larve whether the water in which they live is pure or impure; and streams which are contaminated live is pure or impure; and streams which are contammated with sewage often contain them an great abundance. There are no externally visible organs of respiration, but the akin is supplied by an abundant network of the itraches blanches, which, no doubt, take up oxygen from the well-acrated water in which the animal lives. From this network at the surface, branches pass to supply all the internal organs. The Simulton larva is found upon aquatic weeds, and the pair of hind feet, which in found upon square weeds, and the pair of hind feet, which in Chinomona were shaped to as to enable the larva to hold on to its burrow, here become altered, so as to firmth a new means. The two obstares of hooks found in the Chinomonas larva form now a circular coroner, and the centre of the inclosed space becomes capable of being retracted by means of united swhich shape to the most of the contract of the inclosed space, which is, no doubt, aided by the citized of shap hooks. Efficient as this adherite organ andoubtedly n, it must be liable to de-rangement by occusional accidents, as, for instance, if there energement by occusional accidents, as, for instance, if there should be a sudden rush of water of unusual violence, or if the larva should be obliged to quit its hold in order to avoid some dangerous enemy. In the case of such an accident it is not larva should be colleged to quat its note in over to avoids some diagnetous enemy. In the case of such an accident it is not easy to see how it will ever recover it footing. Swept along in a rayed current, we might suppose that there would be but a stender probability of its ever finding itself favourably placed genies have been carefully proched for. The shirtway glants, or silk-organs, which the Chinonomic larva uses in weaving the sile of the sile of the shirt of th wall of its burrow, furnish to the Simulium larva long mooringthreads, by means of which it is anchored to the leaf upon which it lives. Even if the larva is dislodged, it is not swept far by the stream, and can haul itself in along the mooring thread in the

stream, and can haul issell in along the mooring thread in the same way that a spider or a Geometer larva climbs up the thread by which, when alarmed, it descended to the ground When the time for pupation comes, special provision has to be made for the peculiar circumstances in which the whole of the aquants life of the Simulum to passed. An inactive and exposed pupa, like that of Chironomus, may fare well chough on the soft muddy bottom of a slow stream, but such a pupa Simuluin is most at home. When the time of pupation draws Simulatin is most at home. When the time of pupation draws near, the insect constructs for itself a kind of nest, not unlike in near, the insect constructs for itself a kind of near, not unlike in shape the nest of some swallows. This nest is glued fast to the surface of a water weed. The salivary glands, which furnished the mooring-threads, supply the material of which the nest is composed. Sheltered within this smooth and tapering case, whose pointed tip is directed up stream, while the open mouth is thined down stream, the punk rests securely during the time

of its transformation.

When the pupa case is first formed, it is completely closed and egg-shaped, but, when the insect has east the larval skin, one end of the case is knocked off, and the pupa now thrusts one end of the case is knocked off, and the pups now thrests of the control of the case is knocked off, and the pups now thrests of the control of the contr the fore part of its hody into the current of water. The respiracocoon

The larva of the gnat is perhaps more familiar to naturalists of all kinds than any other aquatic Dipterous insect. interesting description, and, above all, the admirable engravings, of Swammerdam, now more than two hundred years old, are familiar to every student of Nature.

familiar to every student of Nature.

The larva, when at rest, floats at the surface of stagnant water. Its head, which is provided with vibratile organs suit able for sweeping minute particles into the mouth, is directed downwards, and, when examined by a lensi in a good light, appears to be bordered below by a gleaning bad. There are no thoncic limbs Theind-limbs, which were long and hooked in the burrowing Chrinomusi larva, and reduced to a bookin the burrowing Christonomus larva, and restaced to a Boos-bearing sucker in Simulium, now distappear allogether. A new and peculiar organ is developed from the eighth segment of the abdomen. This is a cylindrical respiratory sphon, reaversel by two large air-tubes, which are continued along the entire length of the body, and upply every per with air. The larva cordi-arily rests in such a position that the tip of the respiratory sphon is find with the surface of the water, and, thus say aphon is flash with the surface of the water, and, thus use pended, if each measurily, therething uninterrupedly at the product, if each increasanty, therething uninterrupedly at the migration of an increase and the product of the

savancing tail foremost. When it reaches the top, it hangs as before, head downwards, and resumes its feeding-operations. In order to explain bow the larve hangs from the surface against gravity, I must trouble you with some account of the properties of the surface-film of water. You will readily believe

that I have nothing new to communicate on this subject, and I that I have nothing new to communicate on this support, which wenture to show you a few very simple experiments, merely because they are essential to the comprehension of what takes

place in the gnat. in any reased of pure water, the particles at the surface, though not differing in composition from those beneath, are nevertheless in a peculiar state. I will not travel so far from the region of natural history as to offer any theoretical explanation of this of natural history as to ofter any theoretical explanation of this state, but will merely show you experimentally that there is a surface film which results the passage of a solid body from beneath. [Meabraugghe's float shown] You see (1) that the float is sufficiently lawyant to rice well out of the water, (2) that, when forcibly submerged, it rises with case through the water as far as the surface film. (3) that it is detained by the surface than the surface film. film, and cannot penetrate it. The wire pulls at the surfacehim, and cannot penetrate it. The wire pulls at the autrace-film and distorts it, but is unable to free itself. In the same way the surface-film re-ists the passage of a solid body which attempts to penetrate it from above. This will be readily seen if we throw a loop of aluminium wire upon the surface of water [Experiment shown] The loop of wire floats about like a stick of wood Aluminium is, of course, much lighter than iron, but the floating of this little bar does not mean that it has a lower density than that of water. If the bar is once wetted, it sinks to the bottom and remains there Even a needle may, with a little care, be made to float upon the surface of perfectly pure water. Still more readily can a piece of metallic game be made to float on water. [Experiment shown]. Air pass through the metales with no visible obstruction. But the pass through the metales with no visible obstruction. But the varies flim, bounding the air and water, is entirely unable to invoice even meales of appreciable size. These simple exper-ience of the properties of the prope of perfectly pure water Still more readily can a piece of metallic were unknown

We may now try to answer three questions about the larva of

the gnat, viz .- (1) How is it able to break the surface film when it swims upwards? (2) How is it able to remain at the surface without muscular

effort, though denser than water? (3) How is it able to leave the surface quickly and easily when elermed?

The tip of the respiratory slohon is provided with three flaps. the let por the respiratory sipaon is province with three maps, to large and similar to one another, the third smaller and differently shaped. These flaps can be opened or closed by attached muscles. When open, they form a minute basin, which, though not completely closed, does not allow the surface film of water to enter. When closed, the air within the uphon is unable to escape At the time when the larva rises to the surface, the pointed ups of the flaps first meet the surface filin, and adhere to it. The attached muscles then separate the flaps, and in a moment the basin is expanded and filled with air. The surface-film is now pulling at the edges of the basin, and the pull is more than sufficient to counterbalance the greater density of the body of the larva, which accordingly hangs from the sur-face without effort. When the larva is alarmed, and wishes to

face without effort. When the larva is alarmed, and washes to descend, the values close, then tips are brought to a point, and the reasting pull of the surface-film is reduced to an unimportant mount. Larvage larves shown by the instern, let the property of the property of the larvage of th properties of the surface-film explain all the phenomenaice-film is unable to penetrate the fine spaces between the flaps for precisely the same reason that it is unable to pass through the meshes in a piece of gauze

After three or four moults the larva is ready for pupation. By

this time the organs of the future fly are almost complete formed, and the pupa assumes a strange shape, very unlike that of the larva.

At the head-end is a great rounded mass, which incloses the wings and legs of the fly, beside the compound eyes, the mouth-parts, and other organs of the head. At the tail-end is a pair

* A number of other experiments illustrating the properties of the surface-film of water, are described by Prof. Boys in his delightful book on "Sono

of flaps, which form an efficient swimming-fan. The body of the pups, like that of the larva, is abundantly supplied with air-tubes, and a communication with the outer air is still institutional, though an an entirely different way. The air-tubes no longer open towards the tail, as in the larva, but towards the bead, placed that is a position of rest the margins of the transposition of the placed that is a position of rest the margins of the transposit come flash with the surface of the water. Floating in this position, the paper remains still, to long as it is undustried, but if attacked by any of the predatory aimnals which abound in fresh waters, it is also for detected by the powerful swimming move-

ments of its fail in

Not that the descent is without its difficulties. The pupa is
not like the larva, denier than water, but buoyant. There are
not like the larva, denier than water, but buoyant. There are
the the pupal to be a superior of the larva the

If we take a solid body, capable of being wetted by water, and place it in water, the surface-film will udliere to the solid. If the solid is less dense than the water, it will float with part of life the solid is less dense than the water, it will float with part of flow for the water of the solid water of the solid water for solid is dense film will be formen upwards around the solid will be pulled than the water, the variance film sound the solid will be pulled with the water of the water floats with part of its surface in contact with at, and that weights are gradually added to it. The result will be that the variance of the water around the part of the water around the part of the water water water water floats with part of its surface in contact with a road water water floats with part of its surface in contact with a road water floats with part of its surface in contact with a road water floats with part of its surface water wa

of the wirface-film
This state of things may be illustrated by a model [Float
This state of things may be illustrated by a model [Float
This state of the state o

have observed more than the closed tube, the slightly open tube, and then the suddlen change to a completely upon condition and then the suddlen change to a completely upon condition. Another Dipterons have described and admirably figured by Swammerdan is the larva. Of stratuony, a larva which, as the structure of the fly shows, belongs to an altogether different emodely connected with the grant in the systems of scollegists, the Stratuonya larva has learned the same lesson, and is equally self-structured and the structure of t

membrane, it might foot and breathe prefetely well, but but old office the service of the prefetely well and the foreign latel foot of the prefetel with the service of the service collapse and their points approach; the idde-branches are folded in and the beam is in a moment reduced to a pear-shaped body, filled with a globale of air, and reaching the surface of the water at the first but of danger, swamming through the water with swaying and looping movements, somewhat like those of Chrisomins. When the danger is past, it canes to straggle, and floats again to the surface. The pointed up of its tall-ringe the floating beam is revorted.

the floating basin is restored. The larva of Strationys is extremely elongate. The length of its body has evidently some relation to the mode of life of the larva, but none at all to that of the fly which is formed within it. The puper is so much smaller than the larva as to occupy only the fore-part of the space within the larval skin. The interval becomes filled with air, and during the pupal stage the animal floats at the surface within the emby larval skin.

Strateomy, both in its larval and pupal nates, floats at the surface of the water. The larva, can descend into the water when attacked, but the pupa is too buoyant, and too much commerced the control of the pupal too buoyant, and too much commerced the control of the pupal to the superior of the helpless pupa against its many encours. It is probable that many many the pupal to th

The larva and pupo of the Dipterous fly, Psychopters pshaloine, exhibits one interesting adaptation of the trached system to unusual conditions. This larva is found in muchly distribes, where the larva is found in muchly distribes, where the larva is found in muchly distribes, where the larva is considered to the larva from the larva

Two trachesi trunks run along the whole length of the body, moduling the island rul, where they are extremely convoluted and uniterached. Towards the middle of the body the traches evening portions, from which many branches are given off, being comparatively narrow. Each tube, therefore, resembles a you of bladders connected by small needs a A cross-section shows that the tubes are not sylundruct, but flastened, and the theorem of the contraction of the contraction of the state of the contraction of the state of the state of the contraction of the state of the state of the contraction of the con

³ So singular is the disproportion between the larva and the pupa that some naturalists have actually described the latter as a paramie (Westwood's "Mod Classification of Insects," vol is p 530.

that the buoyancy of the larva can thus be regulated, and a larger or smaller quantity of art taken in a steined. The pape has a pair of respiratory tubes, which are carried, not on the tail, but on the thorax, close behind the head. One of these tubes is very long, the other very short. The long tubes is twice a long as the body, and tapes very gradually to its free tip Here we find a curious radiate structure, rather like the teeth of a moss capsule, which seems adapted for opening and closing. There is, however, no orifice which the most care-ful scrutiny has succeeded in discovering. A delicate membrane extends between the teeth, and prevents any passage inwards or outwards of air in mass. The tube incloses a large trachea, the continuation of one of the main tracheal trunks. This is stiffened by a spiral coil, but at intervals we find the coil deficient, while the wall of the tube swells out into a thin bladder occen, while the wall of the tube swells out into a thin bladder. However the tube is turned, a number of these bladders come to the surface. As the pupa lies on the surface of the mud, the filament floats on the top of the water, and the air is renewed without effort through the thin-walled bladders.

Why should the position of the respiratory organs be changed from the tail-end in the larva to the head-end in the pupa? from the tail-end in the larva to the head-end in the papira? Chronomus, the gnat, Coretina, and many other aquation is seets exhibit the same phenomenon. Evidently there must be some reason why it is more convenient for the larva to take in air by the tail, and for the pupa to take in air by the head. Let us consider the case of the larva first. Where it floats from the surface, or pushes some part of its body to the surface, it is plain that the tail must come to the top and bear the respiratory outlet, for the head bears the mouth and mouth-organs, and must sweep to and fro in all directions, or even bury itself in the mud in quest of food To divide the work of preathing and feeding between the opposite ends of the body is of obvious advantage. for the breathing can be done best at the top of the water, and the feeding at the bottom, or at least beneath the surface Such considerations seem to have fixed the respiratory organs at the tail of the larva Why, then, need this arrangement be reversed when the insect enters the pupal stage? There is now no feed when the insect enters the pupal stage? There is now no feeding to be done, and it startly does not signify how the head is upon the pupal stage. It is not startly a startly as startly a startly a startly as startly a startly as startl transport to the second of the plan institute to concerned, any good trute. But at time ones when the fly has to except from the pape case. The skin splits along the back of the thorax, and hee the fly menger, extracting its legs, winey, head, and must be drawn backwards out of their farval sheaths, the legs upwards, and the sholmen forwards, to that there it only one possible place of escape, me by the back of the thorax, when the cacape by the back of the thorax, the the cacape by the back of the thorax, the back of the thorax must float uppermost during at least the latter part of the pupul single the second of the control of the second of the control of

I need hardly speak of the many insects which run and skate on the surface of the water in consequence of the precluiar properties of the surface-time. They are able to do so, first, by other times of the surface of I need hardly speak of the many insects which run and skate

In the case of very small insects, it becomes possible, not only In the case of very small macets, it Decomes possible, not only to run on the surface of the water, but even to leap upon it, as upon a table. This is particularly well seen in one of the smallest and simplest of all insects—the little black Podura, which abounds in sheets of still water The minute and hairy body of the Podura is incapable of being wetted, and the Insect body of the Fodura is incapable of being wetted, and the insect files about on the silvery surface of a pond, just as a house fly might do on the surface of quicksilver. This is all very well so long as the Fodura is anxious only to amuse itself, or move from place to place, but it has to seek its food in the-water, and, indeed, the attractiveness of a sheet of water to the Fodura lies mainly in the decaying vegetation far below the surface But if the maset is thus incapable of sinking below the surface, how

does it ever get access to its submerged food? I have endea-voured to arrive at the explanation of this difficulty by observa-tion of Poduras in captivity I flow place a number of Poduras in a beaker half full of water, they are wholly unable to sink in a lieaker half full of water, they are wholly unable to sink They run about and leap upon the surface, as if trying to escape from their prison, but sink they earnot 1 have chased their about with a small rod until they became excited and much about with a small rod until they became excited and much large quantities of alsohol were added to the water, the dead bodies of the Podura are seen froating at the top, almost a set ies of the Podura are seen floating at the top, almost as dry as before. It is only when they are placed upon the surface of strong alcohol that the dead hottes become wetted, and after a considerable time are seen to sink. How, then, does the Poduia ever descend to the depths where its food is found?

Podua ever descend to the depths where its food is found?

I found it an easy matter to make a ladder, by which the Poduze could leave the upper air. A few plants of duck weed introduced into the beaker enabled them at pleasure to pull theuselves forcibly through the surface film, and climb down the long root banging into the water like a rope. Once below the surface, the Podura, though buoyant, is enabled, by muscular exertion, to swim downwards to any depth

Other aquatic insects, not quite so minute as the Podura, experience something of the same difficulty. A Gyrinus, or a small Hydrophilus, finds it no easy matter to quit the surface of the water, and is glad of a stead or root to descend by

To leave our aquatic insects for a moment, we may notice the habit of creeping on the under side of the surface-film, which is so often practised by leeches, snails, cyclas, &c 1 find this is often described as creeping on the air, and some naturalists of the greatest eminence, speak of fresh-water snalls as creeping "on the stratum of air in contact with the surface of the water." "on the stratum of art in contact with the surface of the water".

The body of the animal is, nevertheless, wholly immersed during this exercise, as may be shown by a simple experiment. If I youngodium powder is sprinkled over the water, the light particles are not displaced by the animal as it travels be particles are not displaced by the animal as it travels be maint. The possibility of creeping in this manner depends, of the body, "to quote an explanation which is often given, but upon the tennesty of the surface fails, when severe as a kind of coling to the water-chamber below. The body of the feech is coling to the water-chamber below. The body of the feech is quality to the bottom, if the animal loses it the lost of the surface-film. The pond snaits, however, actually float at the surface-ant I dausted, or made to retract their foot, they precely nurn ow r in the water

owe in the water. What is the result of all the expedients which have enabled air breathing insects to overcome the difficulties of living in water? They have been successful, we might almost say too successful, in gaining access to a new and ample store of food. Aquatic plants, minute animals, and dead organic matter of all kinds abound in our fresh waters. Accordingly the species of aquatic insects have multiplied exceedingly, and the number of adjustic insects have indusprise executingly, and the number of individuals in a species is sometimes surprisingly high. The supply of food thus opened out is not only ample, but in many cases very easy to appropriate. Accordingly the head of the have degenerates, becomes small and of simple structure, and may be in extreme cases reduced to a mere shell, not inclosing the brain, and devoid of eyes, antenne, and jaw. The organs of locomotion also commonly afford some indications of degeneration. Where the insect has to find a mate, and discover generation where the insect in as to find a mate, and curvover suitable sites for egg-laying, the fly at least must pos-ess some degree of intelligence, keen senve organs, and means of rapid locomotion. But some few aquatic in-eets, as well as some non-aquatic species which have found out an unlimited store of food, aquatic species which have found out an untimited store of food, manage to produce offspring from unfertilized eggs, and to have these eggs lard by wingless pupe or hatched within the loodies of wingless larvæ. The development of the winged fly, the whole business of mating, and even the development of the embryo within the egg, have thus, in particular insects, been abreviated to the point of 'ppression' This is what I mean by saying that the pursuit of a new supply of food has in the case of certain aquatic insects proved even too successful. Abundant

cerain square insects proved even too successful. Abundant food, seeding no exertion to discover or appropriate it, has led in a few instances to the almost complete atrophy of those higher organs and fauctions which alone make life interesting. The degeneration of aquatic insects, however, very rarely reaches this extreme. In nearly all cases the pupe is succeeded by a fly, whose activity is in striking contrast to the sluggaliness.

Semper's "Animal Life," Eng tram , p 205, and note 97

of the laws. They differ, to the eye at least, almost as much as air differ from water.

Of the frends to when the state of the laws to be a consumer to the state of the stat

FORTHCOMING SCIENTIFIC BOOKS.

ThE following announcements are made by Mears Macmillan and Co — "Essays on some Controverted Questions," by Th. Hustley, F.R. S. "Dr Schlemans" Exercations at Troy. Tryris, Mycene, Ortomenos, Ilhaca, presented in the light of recent knowledge," by Dr. Carl Shuchhardt, authorized translation by Mine Eugenie Sellers, with appendix on latest researches by Dr. Schlemann and Dorgfeld, and introduction by Walter Trym, Mycene, Orchomenos, Ihara, presented in the light of creent Anonleigh, by Dr. Cas Buchhards, authorized transferent Anonleigh, by Dr. Cas Buchhards, authorized transferent Anonleigh, by Dr. Cas Buchhards, authorized transferent and the Castella and Castella a

Hempel, Ph. D., transited by D. L. M. Donnis, "Nuture's Story Books," I. "Sunshine," by Any Johnson, literated. The Cambridge University Press anatomotes: "Calalogue of Scientific Papers Compiled by the Royal Sociaty of London," and the Cambridge of Cambridge, "Sociaty of London," and the Cambridge of Anther Cayley, So. D., F. K.S., Sallerian Professor of Fure Mathematics in the University of Cambridge, "Only of the Cambridge," and the Cambridge, "London," of London, "Sociation of Cambridge, "London, "Foreston of Anguled Mathematics, University College, and Professor of Applied Mathematics, University College, and Professor of Applied Mathematics, University College, and Professor of Applied Mathematics, University College, "Solutions," of the Examples in a Treatise on Elementary Dynamics," new and enlarged chinon, by S. L. Loney, Fellow of S. John's College, Cambridge, "A Hastory of Epidemics in Biratia," Vol. 1, from bridge, "A Hastory of Epidemics in Biratia," Vol. 1, from bridge, "A Hastory of Epidemics in Biratia," Vol. 1, from University of Cambridge, "Catalogue of Type Fossis in the Woodwardtan Museum, Cambridge," by H. Wood, of S. Hoshitows in the College of the University of Cambridge, "Catalogue of Type Fossis in the Enhancement of Cambridge," by H. Wood, of S. Eshbuttons, in the College of the University of Cambridge, "Learning to Cambridge," and the College of the University of Cambridge, "Catalogue of Type Fossis in the Eshbuttons in the College of the University of Cambridge," Fabbitions in the Colleges of the University of Cambridge."

Part I Mathematics and Science, Part II Classins, Mediaval and Mofern Languages, and History (Michaelma Term, 1800).

The College of College of the College of College Exhibitions in the Colleges of the University of Cambridge "— Part I Mathematics and Science, Part II Classics, Medicayal

those who take a general interest in science, but are unfamiliar with the details of chemical investigation, to gain a general idea

of the development of theoretical chemistry); "The Dynamics of Rosation," by A. M. Worthington, Professor of Physics, and Head Master of the Dockyard School, Portsuomity, "The Principles of Chemistry," by D. Mendeleieft, Professor of Chemistry, by D. Mendeleieft, Professor of Chemistry, by D. Mendeleieft, Professor of Chemistry, and edited by A. J. Greenaway, Sub-Editor of the Journal of the Chemistal Society, a vols, ; "A Manual of the Seenes of the Chemistry, and the Chemistry, and Carlotte of the Journal of the Chemistry, and Carlotte of the Chemistry, and the

Messes, Sampson Low, Martino, and Commonice or "Messes, Sampson Low, Martino, and Co smonices: "Theory and Analysis of Ornascen," applied to the work of elementary and technical shoots, by Francisch Iona Schauersann, for eight necessary of the Common Commonical Commonica Com contact and immersion processes, the colouring of metals, the methods of grinding and polishing, &c, translated from the German of Dr. George Langbein, with additions by William T Branut, editor of "The Techno-Chemical Receipt Book," 1 Branut, entitor of "the Lechno-Chemical Keccipi Hook," for collective by 12 sengrerings, "Handwring in Relation Congress of Hygies and Demography, London, By Indian Relation and the Report of the Commission of Specialists appointed by the Imperial and Royal Supreme Council of Health, Vienna, 1891.

Health, Vicina, 1891
The next volume of the Contemporary Scence Series, published by Mr. Walter Scott, will be "The Man of Genius," by the Man of Genius, "by Mr. Walter Scott, will be "The Man of Genius," by General State on September 28, with the coponally illustrated illustrated in September 28, with the coponally illustrated in the press a "Test-hook of Merchant of Contemporary of Test," and the Contemporary of Test, an have also in preparation a series of "Guides to the Science Ex-aminations" (the first number, which is nearly ready, is by Mr Jerome Harrison, of Birmingham, and death with the examina-tions in physiography): Pinchericals "Mechanics," in their series to the programmy and the series of the series of the series the opportunity is being taken to adopt it to the revised require-ments of the 18g Syllabas of the science and Art Department. Meiers. A, and C Black have in preparation "Manual of Chemitty," by T. Alers Soct, Jurma, "Manual of Botany," by Dr. Soott, Biokley, "Dictionary of Brids," by Pref Alfred Newton and Dr. Galow.

Newton and Dr. Gadow.
Mestry Whittee and Go announce the following bools—
In Whittaker's Library of Popular Science—"Light," Sort
In Whittaker's Library of Popular Science—"Light, RedicLibrary of Popular Science—"Library Science
Introduction, Colour and the Spectrum, Lenses, Optical
Whittaker's Specialist's Sense—Prod. Oliver Lodge's work
Whittaker's Specialist's Sense—Prod.
Whittaker's Specialist's Sense—Prod.
Whittaker's Specialist's Sense—Prod.
Whittaker's Specialist's Sense—Prod.
Whittaker's Specialist's

Walls, "The Drausge of Habitable Buildings," by W. Lee Beardmore, Member of the Cosmal and Hon. See of the Cost and Mechanical Engineers' Society; a fourth reserved and reharged edition of "The Working and Management of an enlarged edition of "The Working and Management of an Allantic Liner, with a Retrospect of the Trade," by A.J. Magnans, receilly Assusant Superintendent Trade, "by A.J. Magnans, the Magnetis, "The Working and Management of an Allantic Liner, with a Retrospect of the Trade," by A.J. Magnans, the Magnetis, "The Most of Chernote and Magnetism," by W. Ferren Maycock, "The Practical Telephone Earth Hooks and Guide to Telephone Example," by J. Toole, Whitevorth Acholin, 1875, last Chief Co, with 237 libustrations, "The Optics of Photography and Photographic Lenses," by J. Tradil Trajor, editor of the Bratish

Beerinean to the Lancashre and Cheshre Ticrphoine Exchange Co. with 221 illustrations, "The Optics of Througenshy and Photographic Lenses," by J. Traill Tsylor, cluter of the British Journal of Bodesgraphy, "The An and Crail of Cubinet-American Company of the C helfast, second edition, revised and enlarged

SCIENTIFIC SERIALS

American Journal of Science, September —On the capture of councts by planets, especially their capture by Jupiter, by H A Newton The full paper is not now given The completed results will be noted in Our Astronomical Column as soon as they are published —Pleistocene fluvial planes of Western Pennsylvania, by Frank Leverett Some facts are stated which clash with certain conclusions drawn by Mr P Max Foshay in a paper entitled "Pre-Glacial Drainage and Recent Geological History of Western Pennsylvania," which appeared in the November number of the Journal From these appared in the November number of the Fournial From these it appears that the obsades to a northward discharge of the Sheanago, Mahoung, and Beaver are, on the whole, greater than those in the way of a southward discharge in the Monongahela, Lower Alleghany, and the Ohio valleys, the available evidence all indicates southward discharge along the present course of the Ohio from the inter-Glacial period to the present time -A method for the determination of antimony and piecent time —A method for the determination of antimony and its conditions of oxidation, by F. A. Gooch and H. W. Griener —A method for the estimation of chlorates, by F. A. Gooch and G. S. Smith —Dampening of electrical oxidiations on iron wire, by John Trowbridge. The experiments lead to the consecution of the control of the control of the consecution of the control oxidiations of high frequency. This influence is so great oxidiations of high frequency. This influence is so great with the oxidiations may be reduced to a half-calculation on a circuit of suitable self-induction and capacity for profusing them. be changed. Only a half-oscillation has been obtained on iron wires, so this law cannot be stated definitely - (3) Currents of high frequency, such as are produced in Leyden jar discharges, therefore magnetize the iron —Genesis of iron ores by isomorphous and pseudomorphous replacement of limestone, &c., by James P Kimball. The author adduces a considerable amount of evidence showing that such products of epigenesis as amount of evidence snowing that said products of direct pseudo-morphous replacement of isomorphous calcu carbonate, like himestone, calcute, calcusinter, calcareous sediments, &c. And hméxtone, calcite, calc-miter, calcineous secliments, &c. And the general proposition is therefore advanced that deposits of concentrated iron ores occur far more extensively as pseudomorbon suplacements than is usually supposed—On the constitution of the constituti

gravels are of the pre-Pleistocene age —Note on the causes of the variations of the magnetic needle, by Prof Frank H Bigelow (See Our Astronomical Column)—Notice of new vertehrate fossils, by O. C. March

THE American Meteorological Journal for August contains the following articles —Mountain meteorology, by A. L. Rotch. The author points out the advantages of mountain stations at which regular and continuous observations can be made as com-pared with fragmentary observations in halloons. The chief characteristic of the pressure at high altitudes in temperate and pressure in winter, thus the barometer varies inversely at high and low levels. With elevation above the sea, the absorption of aqueous vapour diminishes, or inversely, solar radiation in creases. In the Himalayas a black hulb thermometer in vacuo hade lennerature was only 75. In general, the annual range shade lemperature was only 75. In general, the annual range of temperature diminishes with height, so that at an elevation of about 39,000 feet, which is the height of the cirrus clouds, probably the temperature is constant throughout the year. The nygrometric conditions at high altitudes are subject to rapid accompanied by analogous thermal changes. In all mountainous ing into the valleys during the day, and out from the valleys during the night. On calin, clear, winter nights the air in the valleys is often colder than on the mountain slopes. The author meteorological science is due to the establishment of mountain stations, and that in comparing the work done by various nations to advance monniain meteorology, France stands un-rivalled. The German and Austran stations are frequently badly placed, being located in inns below the suminits Among the best stations (in addition to the French) he mentions the Sonnblick, Hoch Ohr, Santis, Ben Nevis, and Mount Washing ton—On the various kinds of gridients, by I. Lisserenc de Bort. This is a translation from the memoirs of the Meteorological Congress held at Paris in 1880, in connection with the International Exhibition The air being put in motion by dif-ferences of pressure, there ought evidently to be a relation hetween the gradient and the wind velocity, but although the wind increases with the gradient, there is no exact ratio, nor a constant relation from day to day. The author reviews the subject in connection with changes produced by temperature and dynamic effects upon the rectifinear movements of the atmodynamic effects upon the restributes movements of the atmosphere, and the movements caused by the carth's rotation, and sphere, and the movements caused by the carth's rotation, and of the supermounded layers, the effect of which ought to be revised by the post-ration—The clumate history of Lake Bonneville, by R de C Ward. This is an abstract of a monograph by J & Gilbert, published by the United States Geological Survey. The paper is chiefly geological, but has an important bearing upon the secular changes in climate Lake Bonneville was the upon the secular changes in climate ancestor of the great 'Silt Lake of Utah, which has frequently altered its level, even in recent years. At the time of the glacial attered its fevel, even in recent years. At the time of the gindeal epoch its level was about 300 metres higher, and it occupied about ten times it yessent area. The cause of the drying up of a large part of the former area is found in the prevailing winds which, on their way from the Pacific and in their passage over the Siera Nevaids, have precipitated much of their moustower. ture, and pass over this region as drying winds —The other articles are observations at a distance (by means of electricity), by T. P. Hall, ocean fog (the causes which produce it), by E. Carriott, and water spouts (observed on a voyage), by Prof C. Abbe

SOCIETIES AND ACADEMIES.

Academy of Sciences, August 31.—M. Duehartre in the chair —Comparative amatomy of plants, by M. A. Chatin. In presenting this recently published work to the Academy, the author summarizes the results of his researches on Phanetogame. plants contained in it and former volumes -Studies relative to plant moderate and the second second

the precision requisite in the measures of a prototype, and that the international metre and national standards defined by the equations sanctioned by the General Conference of Weights and Measures, represent a many of hands easures represent a unit of length sensibly different from the Measures represent a unit of length sensibly different from the Anderser mire. They are shorter by about 26 μ = On a prodeferment of the sensible sensibl diameter

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Lesson in Art. Hum Nated (Chanc)—The Bettermyngen ynd prominen in the Chance of the Cha

CONTENTS.

An Evolutionary Castigation Ry Prof. R Meldola.

PAGE

The Evolutionary Custigation 19 1100 it including	
FRS	441
The Laws of Force and Motion By A G G Our Book Shelf:	443
Emtage "An Introduction to the Mathematical	
Theory of Electricity and Magnetism" .	443
Sergucyess "Le Sommeil et le Système Nerveux	
Physiologie de la Veille et du Sommeil"	444
Hewitt "Elementary Science I e-sons"	444
Cracknell "Solutions of the Examples in Charles	
Smith's 'Elementary Algebra'"	444
Letters to the Editor:-	
The Anatomy of Heloderma - G A Boulenger	444
A Straight Hand -A, d'Abbadie (de l'Institut)	444
Cordylophora lacustres - Henry Scherren .	445
Absolute and Gravitation Systems - Frederick Slate	445
Eucalyptus as a Disinfectant -J. Brendon Curgen-	
ven .	445
Alum Solution - Harry Napier Draper .	446
A New Keyed Instrument for Just Intonation,	
(Illustrated) By Dr William Pole, F R.S.	446
The New Australian Marsupial Mole-Notorycles	
typhlops By Dr P. L Sclater, F.R S.	449
Francis Brunnow, Ph D , F R.A.S.	449
Notes	450
Our Astronomical Column:-	
Solar Observations	453
Connection between Terrestrial Magnetism and	
Radiant Sunlight	453
Two New Asteroids Physics at the British Association	453
Chemistry at the British Association	453
Some Difficulties in the Life of Aquatic Insects. By	455
Prof. L. C. Miali	
Forthcoming Scientific Books	457 462
Scientific Serials	
Sectables and Anadomics	463 464

THURSDAY, SEPTEMBER 17, 1891.

ANIMAL CHLOROPHYLL

Die Organisation der Turbellaria Acala Von Dr Ludwig von Graff. (Engelmann, 1801)

LIGHT years ago Dr. von Graff published his great monograph of the Rhabdocel Turbellarians. The improved methods of histological research have enabled him to add some essential facts since that date to our knowledge of one of the most curious groups of the Rhabdoccila-amnely, those known as Accela In 1885, he passed his Easter holidays at the Franciscan convent on the Dalmatic island of Leana, and on the sea-shore of the garden of the convent found Convoluta Schultzu and canera in abundance.

Prof Delage in 1886 published his valuable researches on Comoluta Roscoffents, the green species of Roscoff, in which he made use of a method of gold-impregnation for demonstrating the nervois system Dr. von Graff visited Roscoff in the same year, and in 1889 studied the Accila at the Naples Station by ineans of Delagés and other methods of gold-impregnation. The present volume deals with Propriets viences, O. Schim, Nompopous vientrymutatus, O. Schim; Afphanostoma diversioler, Oerst, and several species of Convoluta, 1 their ghown amongst other facts that the Roscoff species studied by Geddes and Delage is distinct from the Mediterranean C. Schultzus, and that C. unrea, Graff, must be placed in a new genus, Amphacharus.

The work is illustrated by ten quarto plates, coloured A variety of important anatomical and histological details are given, and a systematic discussion of genera and species Dr. von Cariff discusses the relationship of Truloplar to the Accela, having received living specimens of this curious form from the aquarium of the Coological Institute of Vienna, but he does not allude to the Holpdains piger of Weldon (Quarterly Tournal of Microscopical Scenez, vol xxx), a floating form, taken off the Bahamas, which seems to be certainly a member of the group.

The chief matter of interest in Dr. von Graff's volume. which we propose to notice at greater length, is the chapter by Dr. G. Haberlandt, on "the structure and significance of the chlorophyll-cells of Convoluta Roscoffensis" Dr. Haberlandt states that the description by Geddes of the chlorophyll of this form, as diffused in the general plasma-body of certain cells, is erroneous The green-coloured cells he well below the cuticle, embedded amongst the cells of the superficial parenchyma According to Haberlandt they are highly compressible and elastic. and devoid of anything like a cellulose envelope or even a membranous envelope. They are not uniformly green, but there is as a rule a single large chloroplast which forms a more or less complete shell to the protoplasm of the cell-body. In some of the cells Haberlandt could detect several peripheral plate-like chloroplasts. The crust-like chloroplast contains as a rule a single centrally placed pyrenoid of spherical form. As an exception two or even three pyrenoids are present. The pyrehoid is colourless: it is stained by hæmatoxylin or by borax carmine, but by no means so strongly as is the nucleus of

the cell in which the chloroplast occurs. Starch granules in the form of small curved rods are grouped around the pyrenoid (sometimes within it), and are detected by a violet-invon reaction on addition of sodine solution. The colouries protoplasm of the cell is small in amount as a compared with the enveloping chloroplast: its nucleus is studied in the colouries protoplasm only rendered visible by staming. The colouries protoplasm sometimes contains a group of granules of doubful nature, erroneously taken by Geddes for starch granules.

The resemblance of these cells, especially in respect of the stincture of their chloroplasts and pyrenously, to certain cells which constitute the uncellular bodies of Volvocinea, Tetrasporea, and Pleumococacaca, is insisted upon to by Haberlandt. He raises the question as to whether they are to be regarded as passitic Alge in the sense of the theory of Entr and Brandt, and suggests another hypothesis—manley, that, withis phylogenetically they must be regarded as Alge (that is to say, have descended from Alga), by at the present time they have by profound adaptation to life in and with the Convoluta, allowing gether lost their character as independent algal organisms, and have become an integral histological element of the worm, and in fact constitute its assimilation time.

To test this hypothesis he asks (1) How do the green cells get into the body of the worm? and (2) What becomes of them when the worm dies? Can they live in an isolated condition? To the first question he is unable to give an answer, but suggests that they may be handed on from generation to generation of the Convoluta, entering the egg-cell as a colourless minute cell which later develops its chloroplast just as the "leucoplasts" of higher plants are found in the egg-cell, and later become chloroplasts As to the second question, Haberlandt has no doubt. The green cells die when they are removed from the worm's body or when the worm dies He notes in this connection their membraneless character, and regards the loss of a cellulose envelope as one of the modifications which the ancestral parasitic Alga has undergone, rendering it incapable of living an independent life away from the tissues of its host Lastly, Haberlandt justly remarks that similarity to an Alga is no proof that the green cells are really Algæ in nature Haberlandt is inclined to place his theory as to the green cells of Convoluta alongside the suggestion of Schimper as to the origin of the chlorophyll corpuscles of higher plants-namely, that these are due to the union in the remote past of a green-coloured with a colourless organism. In this case and in that of Convoluta the highest phase of symbiotic association is attained, for the green organism can no longer be separated and cultivated apart, as in the case of the Lichens, but has, in fact, become an organ of the colourless organism, multiplying with it and forming an integral as well as a necessary part of its mechanism, and so greatly modified by ages of association as to be now barely recognizable as derived from an independent source. We can well suppose it possible that the green cells of Convoluta might proceed further in their modification, so as to lose the colourless protoplasm and the cell-nucleus; they would then become simple chlorophyll corpuscles like those of higher green plants.

The suggestion thus put forward by Haberlandt is in

complete accord with the view which I have several times expressed in regard to the chlorophyll corpuscies of Hydra viridis and of Spongilla viridis (see Quart Journ. Micr. Sa., vol. xxii p. 229), viz that there is no more reason for regarding them as symbiotic Algae than there is for so regarding the chlorophyll-corpuscles of a buttercup. Whether there is sufficient reason for so regarding the chlorophyll-corpuscles of a buttercup is another question, and one which certainly is not yet decided in the affirmative, though there are considerations which render such a hypothesis one not lightly to be dismissed.

A difficulty in the matter seems to be this-viz that if the chloroplasts of the cells of multicellular organisms are to be regarded as parasitic, why should not those of unicellular Algae also be regarded as parasitic? and if "Zoochlorella," or whatever the hypothetic Alga may be called in the case of Convoluta, can form chloroplasts, why should not the tissue-cells of Convoluta themselves, or of Hydra,

or of Spongilla form chloroplasts?

It is obviously necessary to distinguish for the present (though posubly, as Haberlandt suggests, the one may be derived from the other) the strongly-marked unicellular parasites of Radiolaria and Anthozoa (the "vellow cells") from the green cells of Convoluta, and the chloroplasts of Hydra viridis, of Spongilla fluviatilis, and of many Ciliata. The statement which is current as to the existence of a nucleus in the chloroplasts of Hydra is simply erroneous, and that as to the independent multiplication of the chloroplasts of Ciliate Infusoria when removed from the cell in which they occur is possibly a misinterpretation of a graft-phenomenon. It is to be hoped that Dr Haberlandt will spare the time to study for himselfas he has the green cells of Convoluta-the more readily obtainable chloroplasts of Hydra, Spongilla, and Stentor

Some extremely interesting and suggestive remarks on the physiological and biological phenomena connected with the green cells of Convoluta conclude Dr Haberlandt's chapter E RAY LANKESIER.

STREATFEILD'S PRACTICAL ORGANIC CHEMISTRY

Practical Work in Organic Chemistry By Fredk Wm. Streatfeild, FIC, &c., Demonstrator of Chemistry at the City and Guilds of London Institute's Technical College, Finsbury With a Prefatory Notice by Prof. R Meldola, F.R.S "Finsbury Technical Manuals" (London, E and F N Spon, 1891)

HE numerous manuals of practical organic chemistry which have been published of late years testify to a re-awakened interest in an important subject. Some of these deal with the preparation of various typical organic compounds, others restrict themselves to describing methods of analysis. The present work combines both methods of teaching, and, as a special feature, divides the subject into "programmes of instruction" designed to meet the varied wants of the students attending the evening classes of chemical technology at the Finsbury College, taking into account the special nature of their daily avocations and the purpose to which they

wish to apply their chemistry. Thus, after working through the introductory courses of "operations" and "analysis," and thus familiarizing himself with the general methods of the subject, the student would begin to specialize The brewer would select the programme "ethyl alcohol and its reactions," which includes fermentation and the purification and estimation of alcohol. and touches on allied subjects, such as the preparation of aldehyde, acetic acid, and chloroform The soap-maker would devote himself to the programme, "a study of the preparation and decomposition of ethyl acetate, and of the composition and reactions of some of the natural fats and oils"; thus passing from the simplest case of saponification (hydrolysis) of an ethereal salt in ethylacetate to the more complex cases in the fats. This latter programme also includes the isolation and estimation of glycerol, and its properties; palmitic, stearic, oleic, and elaidic acids, drying and non-drying oils, bromine and iodine absorption of oils, and other matters of interest in this connection. The tar-distiller would carry out the experiments given under "coal tar and coal-tar products"-a very full and satisfactory chapter

This restriction of the field of study is amply justified by the necessities of the case, and only an irreclaimable scientific purist would object to it. Even the ordinary day-student of chemistry, who can devote his whole time and energies to the subject, must work under some similar limitation when he comes to deal with the mexhaustible material of organic chemistry

The experiments given under the various programmes are well selected, and the accompanying descriptions are evidently the outcome of a thorough practical knowledge of the subject. We may make an exception, however, in the case of the preparation of anhydrous formic acid (p. 66) by passing sulphuretted hydrogen over dry copper formate The method is quite obsolete: Lorin's improved process of preparing the pure acid from anhydrous glycerol and anhydrous oxalic acid, drying the 95-98 per cent acid thus obtained with boric aphydride, is now employed Worst of all, the author recommends in this experiment that the sulphuretted hydrogen should be dried by passing it through concentrated sulphuric acid -a blunder which would go far to justify the prevailing impression that organic chemists are not always sufficiently conversant with the facts of inorganic chemistry

In spite of this and one or two other trifling inaccuracies, we cordially recommend the book as a valuable aid to both teacher and student. What it deals with really is practical organic chemistry, and not the spurious substitute which, in the shape of "the detection of not more than one organic acid and one organic base," usurps the name in this country-thanks to the authority of examining boards, the industry of the writers of cram-books, and the credulity of the public.

Prof. Meldola, in his prefatory notice, referring to the evening classes in chemistry at the Finsbury College, says that they "cater for no examination"; and it is perhaps owing to this important circumstance that Mr. Streatfeild, on whom a considerable share of the laboratory teaching of these classes devolves, has been in a position to write a real manual of practical organic chemistry, and not a mere cram-book of tests-written up to syllabus.

TELESCOPIC WORK

Telescopic Work for Startlight Evenings By W F Denning, F.R A.S (London: Taylor and Francis, 1891)

A S might be expected from such an experienced and enthusiastic observer as Mr Denning, this book is thoroughly practical. He is not contented with describing the beauties of the skies, but gives invaluable information as to how to see them best The opening chapters give a very complete history of the invention and development of the powers of the telescope and its acces-These are followed by chapters on the sun. moon, planets, stars, nebulæ, and clusters, the sun being introduced for the sake of completeness, although not comprehended in the title. The question of the relative advantages of large and small telescopes is discussed at considerable length, and one almost gets the impression that large telescopes, except under very favourable conditions, are not desirable possessions. It is very gratifying to note the encouragement given to observers of limited means. To them the book will be of the greatest assist-

ance, both in the selection and use of their instruments. The author's style is such as to make the book very entertaining as well as instructive. Some of his remarks are well worth quoting, as, for example, his opinion of controversy in scientific matters.

"Competition and rivalry in good spirit increase enhusiasam, but there is little occasion for the bitterness and spleen sometimes exhibited in scientific pournals. There are some men whose reputations do not rest upon good or original work performed by themselves, but rather upon the alacrity with which they discover greevances, and upon the care they will bestow in exposing riting errors in the writings of their not-infallable contributions of the contribution of the contribution

Mr. Denning is very emphatic in his opinion that an observer's time is too valuable to be spent in acting the showman to his friends and acquaintances. If all observers were so disposed, there might be reasonable hope for the establishment in this country of some such institution as the Gesellschaft Urania in Berlin, for the special gratification of persons desiring passing glumpses of celestial wonders.

It is scarcely necessary to say that the chapter on meteoric observations is as good as can be More observers are undoubtedly needed in this branch of astronomy, and volunteers will find every full instructions in the pages of this book. In addition to the notes on variable stars given by the author, we would suggest the tracing of the light-curves of a small number of stars by each observer. Anyone at present attempting to determine the laws governing variability will find such information lamentably deficient.

The book is full of important practical details, and an appendix gives the chief new facts up to March 5, 1891

The book does not attempt to deal with spectroscopic matters, but occasional references are made, and it is here; if anywhere, that fault may be found. Thus, referring to the nebula of Orion, it is stated (p. 334) that "the spectroscopic researches of Huggins have shown this nebula to be composed of incandescent gases, so

NO. 1142, VOL. 44]

that the stars telescopically observed in it are probably in the foreground and entirely disconnected from the nebulous mass."

In 1888, however, it was shown by the spectroscope that the stars of the trapezium, at all events, are simply condensations of the matter composing the nebula

Everyone who uses a telescope, or who intends to use one, of whatever dimensions, should read Mr Denning's book

OUR BOOK SHELF

Abbildungen zur Deutschen Flora H. Kursten's, nebst den auslandischen medicmischen Pflanzen und Erganzungen für das Studium der Morphologie und Systemkunde With Woodcuts of 709 Species (Berlin Friedlander und Sohn, 1801.)

FHIS is a wonderfully cheap book, for the price of it is only three marks, and it contains figures with dissections of upwards of 700 plants, illustrating all the natural orders both of Cryptogamic and Phinergamic plants which make up the European flora or are used medicinally The text is confined to the preliminary table of the orders and families, and a final to the preliminary table of the orders and families, and a final to the preliminary table of the orders and families, the second for the certain the preliminary table of the orders and families, and a final to the preliminary table of the orders and families, and a final to the preliminary table of the orders and families, and a final the preliminary table of the price of the pri

in the Thallophyte are divided into 17 families, classed under sorders, Lichenes being maintained as on a par with Alge and Fungi. In Cormophyte there are 16 families under 6 orders, the orders of Sporifiera being Filices, Selagines, Rhisocarpeæ, and Calamariæ In Northocarpe (Gymnosperns) there are 7 families under 5 orders, Balanophorace and Lorantheæ being placed here. Under Teleocarpe (Angosperns) there are 150 families classed under 48 orders, Luccipledons being divided mits Monochlamytees and Dichlamyties, and the latter into Petalantheæ (Polypetales) and Corollamine to International Control of the Corp. The Corp. (Polypetales) and Corollamine to Itembam and Hooker's orders. In lawe such a good and chasp book in English (the text in the original, of course, is German) would be a great boon to students

Elimentary Text-book of Botany for the Use of Schools By Edith Aitkin. 248 pp (London Longmans, Green, and Co., 1891)

This volume has been written to serve as an adjunct to the teaching of Botany in girls' schools, and is the outcome of the author's own experience as a teacher Aitkin arranges the subject-matter in three parts In the first are given the general characters of a number of tirst are given the general characters of a number of selected types of Flowering plants treated in a manner suitable for young girls beginning the study. In the second part the details of Cryptogamic plants are given, commencing with *Protococcus* and Yeast, and so on, up to the Fern. In the third part we return to Flowering plants again from a more comprehensive point of view. This last section concludes with a number of chapters on the leading physiological processes of plants We think the book will be found of service by those for whom it is intended, especially from the fact that Part I is written, generally speaking, on the lines of the Lower Schedule laid down by the Oxford and Cambridge Schools Exa-mination Board The only criticism we have to make on this section is that perhaps the style is a little wanting in vitality and interest. Part II is treated along sufficiently familiar knes, but in Part III., by the introduction of physiological work, with careful instructions as to simple experiments which can easily be performed to illustrate class teaching, we think that the author will have opened up fresh fields of interest in botanical study. The volume is profusely illustrated, many of the figures being new.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions ex-pressed by his correspondents. Nather can he undertake to return, or to correspond with the winters of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications!

A New Mammal from Sumatra.

A FEW years ago a new and interesting mammal, which is exceedingly rare even in its native haunts, was brought to the then President of Plenthanga, PM. A Prays van der Hoeven. This gentleman, who is not only an eager sportsman, but also well versed in natural history, recognized it to be new to science, and to be more closely allied to certain representatives of the Edentiat than to any other order of mammals.

The type-specimen was preserved in captivity for several weeks, was fed on ants, and afterwards on cooked rice, and was weeks, was led on ante, and atterwards on cooker free, and was sent alive to Europe in order to be examined, described, and ultimately preserved in the Royal Museum at Leyden It unfortunately died on board the vessel on its way to Holland, and, by an unaccountable blunder on the part of one of those in charge, its remains were not preserved, but thrown overcharge, tis remains were not preserved, but thrown overhonni

During my own stay in Sumatra, from February till May 1891, I took particular trouble to obtain further information concern-ing this animal, and have found the fact of its existence—though, ing this salmal, and have found the fact of the easternes—though, at the same time, of the exceeding ranty—confirmed in a way which does not allow me to doubt that, ere long, further specimens will be swallbel for a through estimation, also with example the salman of the salman of the second specimen have not as yet been successful, but as they have drawn the attention of many persons to this animal, I feel bound, in deference to the claims to priority of its original. I feel bound, an deference to the claims to priority of its original accoverer, who has put he preliminary description as well as manimal into science, notwithstanding the fact that the type-specimen has been lost. The generic name has been elected, not with a view of indicating any clearer nationneal relations of the salman of the salman

Trichomanis Hoevenis, gen et sp. nov - "Animal of the size of a very large cat. Fur grey, with a black longitudinal band along the middle of the back. Snout elongated and more or along the middle of the back. Shout elongsted and more or less conical, with a small month at the extremity. A long less conical, with a small month at the extremity. A long collection of ants, which are its natural food. A more or less bushy tail. Ears not conspicuous Legs higher than those of Manus, strong claws to the feet."

I have no doubt that this description—however superficial—

is more than sufficient for the recognition of the animal as soon as it will have been reobtained. The type-specimen was caught in the mountainous districts that separate the Residencies of Palembang and Bencoolen in Sumaira.

A.A W HUBRECHI

Utrecht, September 7.

An Ovlparous Species of Peripatus

Perspatus leuckartus has proved to be by no means une in Victoria, being now recorded from a good many distinct localities, and forming a very characteristic constituent of our cryptoroic fanns. Hitherio, however, little has been known of its habits, and nothing of its mode of reproduction. The only tis labits, and anolong of its mode of reproduction. The only to lonerers, to fir at I am aware, who has recorded anything concerning tis life heteroy, as Mr Fletcher, who has described (Frocellum, Soc N SW, Qeother 31, 1885) four very young individual to the control of the c

of the jar on two thin slips of glass, so as to admit of free ventilation I keep a small open jar fall of water inside the large one, and the floor of the vivarium is covered with a thick layer of very rotten wood, kept molat by the evaporation of

isyer of very rotten wood, kept most by the ewportation of the water the conditions Propagation flourness well, and the specimens may be inspected when desired, by turning over the bits of rotten wood. On making such an inspection to day, I found that some twelve or fifteen eggs had been deposited beneath some of the pieces of rotten wood, and in crevices of the same Carefal examination showed that these eggs were modobitedly those of Propagation fluxering. I collected all I could find, and removed them, with some of the rotten wood, to a separate receptacle, and then carefully turned out the vivarium and examined its contents I found that there were present four specimens of Perspains, one male and three females, all apspeciment of respents, one make and time tensions, at ap-parently in good health, and that there was nothing else which could have laid the eggs, a very small ant being about the largest living thing present except the Portpatus It is now some ten weeks since the vivarium was stocked, and as I have carefully examined it several times during that period, I am sure that the eggs must have been recently deposited.

The view that Peripatus Leuckas is is really oviparous receives

The wee that Perspitute Jacobs is a really overpareas receives trong confirmation from anatomical estamlation of adult females. In these I have nearly always found eggs in the uterus, but, although I have discreted speciment staken in December, May, and July, I have never found any embryos. The single end of the month and given to me by Prof. Specimer, it contained mether eggs nor embryos, as it appeared to be adult, it is not unlikely but the eggs that been land. Moreover, the structure of the eggs in utas is very characteristic, and argues strongly squared the probability of instituterine development, their, cleanter membrane inclosing a quantity of thick milky fluid full of yolk remains.

full of yolk granules

I have examined microscopically only one egg after laying, as I wish, if possible, to observe the development, but this one agrees so closely with those found in utero that there can be no doubt of its identity It was of just about the same shape and size ($\frac{2}{2\pi}$ inch long by $\frac{2}{2\pi}$ inch broad), of a very pale yellow colour, with a very tough, elastic membrane, and a milky fluid contents containing very many yolk granules The only difference concerns the almost chilinous looking membrane, which, ence concerns the aminost entitions toloning menutrates, whilest, mistead of having a smooth surface, or nearly so, as when in there, is exquisitely sculptured or embossed in a beautiful and regular design. The design consists of curious little papillar, somewhat resembling worm casts, arranged at fairly regular intervals over the surface of the egg, with much finer, close-sea, intervals over the surface of the egg, with much finer, close-sex, meandering rights occupying the pasce between them. Such exclipturing it, as is well known, characteristic of many interesting in a surface of the control of the co

double brooded (I have used the term "uterus" in accordance with the customary nomendature; it would be britter, perhaps, to speak only of "ordatus" in P lanckarits.)

The mode of reproduction of Perspitati includes its seem thus to differ welely from that known in all other speedes, and to differ welely from that known in all other speedes, and to quantity of food-polic present, it is probable that the development also drifters in a similar way. This i hope to be able to work out, the presence of so much full dand granular yolk will, I fear, render the task very difficult.

ARTHUR DENDY.

University, Melbourne, July 31

The Sun's Radiation of Heat.

A FEW months ago I sent to the National Review a paper, which the editors kindly inserted, on the sun's radiation of heat So far as I am aware, my theory has been completely ignored by those best competent to form an opinion upon the subject. My contention seems so plausible that I venture to suppeal to you to allow me to give the following brief exposition of my view, in the hope that I may be able to elicit some

of my view, in the hope that I may be able to elicit some authoritative replay radiation is at present, for all ments and purposes, expressed in terms of neiting ice. In other words, the sun is supposed to be giving forth as much heat as a constantly renewed shell of ice, or never-failing coans of water. My conception is, that, judging from what we know of hot bodies coling upon the earth, it is impossible to believe that the sun could be pouring forth so much heat under existing conditions, as the would do were he continually or radiate to ice or water close to all parts of his surface.

I ne veiocity, and the rapidity of vibration of the waves of light and heat can be accurately measured. This is the sum of motion—known as radiant heat—which the sun imparts to his surrounding medium. Alsorbed heat is a very different thing (Ballour Stewart), and could not exist without the particles of matter. Now I fall to perceive what grounds the authorities. have for calculating, as they do, that the sun's radiation amounts to something over a million calories per minute for each square metre of his surface. This means a million times the quantity of heat which will raise the temperature of a kilogramme of No doubt if the sun were surrounded b shove would represent a correct estimate of the outflow of heat But the men of science ignore, it appears to me, the marvellous virtue of the "if" in this case. The communication of heat consists in forcing the molecules and atoms of matter asunder against the stiractions of cohesion and affinity, and causing the against the stractions of cohesion and allinity, and causing the particles to wheate, and there is no proof, but the evidence is particled to the steer of the st more quickly than if it were merely exposed to a very dry atmo sphere—that is to say, the metal v rathers that would constitute a less expenditure of energy than its emission of absorbed heat I do not see, therefore, why we should not conclude that exactly the same result, only of course on a very vast time-scale, would happen in the case of the sun

The enormously long periods demanded for the sun's past

life-time by the geologist and biologist furnish strong ante-cedent support in favour of my contention W Goff New University Club, 5 W, August 15

Morley Memorial College

YOUR readers may be interested in hearing of a successful attempt to add another round to the ladder, described by Prof Iluxley, extending "from the gutter to the University" Some supporters of the Morley Memorial College for Working Men and Women, in the Waterloo Road, last year read an account and women, in the waterioo Roat, list year read an account in your pages of the arrangements made by the University Extension Society for some of its students to spend a month at Cambridge during the vacation. They resolved to offer scholarships to those who took the hext places in the Christians and Easter examinations in connection with Mr. McClure's astronomy Easter examinations in connection with Mr McClure's attronomy class, whereby they might avail themselves of these arrangements. This, thanks to Dr. Roberts's kind eo operation, was successfully accomplished. Three students went to Cambridge, the most successful in a class all of whom did well. A plumber and a printer's reader with to Selwyn College, an elementary schoolmitres to Newsham Two were able to take advantage of the whole month; the third (being a family man) could only spare a fortinght from his work, but all speak warmly of the pleasure and profit they have derived. The following are some extracts from their letters.

extracts from their letters.

One says —"I took chemistry and geology on alternate days, be-sides attending the majority of the angle lectures. The work being mostly of a practical kind, has been intensely interesting."

Another, after an enthusiastic description of the place, the architecture, and the College gardens, goes on:—"Everybody was mo! kind, cordial, and sociable, without the slightest suswas mo t kind, cordial, and sociable, without the slightest sus-piction of sittlifies or formality, of condescension or spatronage More than this, everybody we met seemed to be studying our interests especially, and doing all in their power to make our stay as enjoyable as possible. In science, geology was the only subject I was permitted to take up. In literature and art I attended courses on Browning and Tennyson, and on Greek art, Greek instory, and Herodotus, also single lectures on Leopold Ranke, and College Life Past and Present. Leopold Ranke, and College Life rast and Freenith hepe to continue these studies as far as possible in my home reading. Beyond the actual instruction received in the I hope to committee to the reading. Beyond the actual instruction received in the lectures, there has been given an impetus to further study, from which a continuous benefit must be reaped, and I have obtained a clear idea of what a student's life in a University town is like. a clear side of what a student's lie in a University town is like "Cambridge opens its doors in this way only to members of University Extension classes, but at Oxford anyone may attend the clusses who pays the fee The authorities of our College accordingly offered scholar-hips to those of their students who passed highest in the bettered and Art examinations for electricity, passed highest in the Science and Art examinations for electricity, chemistry, and mechanical drawing. The results of these were not known early enough for the first half of the vacation classes, but the second fortnight in August was so much enjoyed that those who made the arrangements considered themselves well those who made the arrangements considered themselves well repaid for their trouble, though this was not small, for working men do not find it easy to get leave of absence for even a fortinght at a certain specified time "One of the most enjoyable holidays I ever spent," writes one, "I lave quite, a collection

holishys I ever spent, "writes one, "I have quite a collection of geological specimens collected on the exercision of geological specimens of geological specimens of geological specimens of the property of and women. Will not the school teacher's work have an added interest and dignity now she has seen (if only by a passing glimpse) what education is in its higher branches? Will not all of them feel that life contains something besides manual drudgery for weekly wages, and that those whose lot is exempt from irulgery of this kind are willing and anxious to share with them the results of culture and leisure? We live in times of a difficult ship between free men, who can be mutually helpful to each other just because their circumstances and advantages are different Feudalism was good in its day, but it has outlasted the conditions which made it so, and the "ladder from the

the conditions which made it so, and the "ladder from the quitte to the University" is an important instrument in effecting the transition analysis ossenshing better, the scholarships receive wher support from the public than they have done, it will be difficult in not impossible in carry them on efficiently? Our fees are necessarily to low that the insuitation can never be self-supporting. We charge it entrance fee, and it of a term for the first class, of for each additional class. Larger fees supporting. We change I entrance fee, and 1: De a term would exclude some of our best students (now who had a perfect pas in for knowledge was a rag solier till a better situation was come for the students (now who had a perfect pas in for knowledge was a rag solier till a better situation was come for the perfect pas in for knowledge was a rag solier till a better situation was formed from that finds, but we have lived on this hope for the last ive years, and find it a saidly insufficient resource to provide medium that the perfect per Art Department, to which we should like to offer this advantage September o EMMA CONS (Hon Sec)

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. WASHINGTON MEETING

THE month of August 1891 was distinguished by the most notable array at Washington of scientific meetings ever held in America The series began with the meeting of the American Society of Microscopists on August 11, and afterwards, consecutively or simultaneously, came those of the Association of American Agricultural Colleges and Experiment Stations; the Association of Official Agricultural Chemists: the Society for the Promotion of Agricultural Science; the American Chemical motion of Agricultural Science; the American Chemican Society; the Conference of American Chemists; the Association of Economic Entomologists; the American Association for the Advancement of Science; the Geo-logical Society of America; and the International Geological Congress.

The fortieth annual meeting of the American Association for the Advancement of Science was held from August 19-25, President Albert B. Prescott, Professor of Chemistry at the University of Michigan, in the chair The attendance of members was large; about one-third of all attending were residents of Washington, most of them employed in the various scientific Bureaus of the Government 227 papers were read before the Sections, and these together with the addresses of the President and Vice-Presidents, Reports of Committees, and other documents, brought up the entire number to 201

Prof George L Goodale, of Harvard University, deliered the annual address as retiring President subject-"Some of the Possibilities of Economic Botany

After giving an account of the meeting of the Australasian Association for the Advancement of Science, held at Christchurch, New Zealand, in January last, which he attended as delegate from the American Association, he proceeded to consider the subject above mentioned An abstract of the address follows

There is an enormous disproportion occasion ber of species of plants known to botanical science and the number of those which are used by man The species of flowering plants already described and named number about 107,000, but the number of species used on a fairly large scale by civilized man does not exceed I per cent The useful plants which are cultivated by man do not exceed one-third of this Can the short hat of useful plants be increased to advantage? After calling attention to the influence which synthetic chemistry exerts by the production of artificial vegetable products which can replace the natural artificial vegetatic profiliris which can replace the industrial products profile to took up the cereal grains as illustrations of the history and improvement of cultivated plants If all the cereals, like wheat, maire, yee, barley, oats, and rice, were now to be swept out of existence, we should not know positively where to turn for new species of grasses with which to begin again. He drew a picture of the condition of civilized man if all the known varieties of the cereal grasses should become extinct, and then pointed out the probable manner in which our experiment stations would have to choose and improve the grains of certain grasses which are not used to-day. He expressed the belief that our well-equipped stations would give us satisfactory substitutes for our cereals within a period not exceeding that of two generations of our race. But why do not experimenters attempt to improve our present neglected resources of this character? Because we all prefer to move in lines of least resistance, letting well enough alone. Plants which have been long cultivated are more susceptible to the influence of changes in surroundings, and hence of improvement, than those which are just removed from the field to the garden Tracing the recent history of our cereals, he expressed his conviction that there is no probability that any new cereals will be added to our present list, but improvements will continue to be made in those which we have,

He included under the term vegetables all plants employed for table use, such as salads and relishes potato and sweet potato, the pumpin and squash, the red or capsicum peppers, and the tomato, are of American origin. All the others are, most probably, natives of the Old World. Only one plant coming in this class has been derived from Australasia-New Zealand spinach (Tetra-

Among the vegetables and salad plants longest in cultivation are turnip, onion, cabbage, purslane, the large 45% NO. 1142, VOL. 44]

bean (Faba), chick-pea, lentil, and garden pea—which have an antiquity of at least 4000 years. Next in age are radish, carrot, beet, garlee, garden-cress and celery, lettuce, asparagus and the leek, three or four legumes, and the black peppers The most prominent recent ones are parsnip, parsley, oyster-plant, artichoke, endive, and from the list.

There is an astonishing number of varieties, which represent an enormous amount of horticultural work, each race (that is, a variety which comes true to seed) having

been envolved by patient care and waiting.

For future development be recommends (1) Arracacha esculenta, of the parsley family, which is now cultivated in South America, near the Isthmus; (2) Ullucus or Ollucus, of the beet or spinach family , (3) the so-called Chinese artichoke from Japan

He recommends a more thorough examination of Japanese vegetables, owing to the similarity of Japanese

and Eastern North American flora

Attention was called to the extraordinary changes produced in the commercial relations of fruits by canning and swift transportation, and the opinion was expressed that before long it would be possible to place many more of the delicious fruits of the tropics in northern markets: and even, with increasing knowledge of microbes, to preserve fruit for almost any reasonable time. Such discoveries would diminish zeal in the search for new fruits

The improvement of fruits within historic times has been such that fruits which would once have been highly esteemed would to-day be passed by as unworthy of

notice

The list of seedless fruits may probably be materially neithered. The common seedless fruits are banana and lengthened The common seedless fruits are banana and pineapple Darwin mentions also bread-fruit, pomegranate, azarole, and date-palms, and says that their size and development are usually regarded as the cause of their sterility, whereas he regards sterility as rather the result than the cause of increased development

Prof Goodale expressed the conviction that there is no reason why we should not have seedless strawberries. blackberries, raspberries, and grapes, coreless apples and pears, and stoneless plums, cherries, and peaches,

propagated by bud-division

Promising timbers and cabinet woods, fibres, tanning materials, rubbers, and similar products were discussed in turn, the last class to be considered being fragrant flowers and plants for the florist. The necessity for caution in the introduction of new plants, lest they should prove pests by their wide dispersion through arable lands, as sweetbriar has in some parts of New Zealand, was fully illustrated. The agencies for examining useful plants were botanic gardens, museums of economic botany, and experiment stations

SECTION A-Mathematics and Astronomy.

The address by Prof E W 11yde, of Cincinatti, the President of the Section, was on the evolution of algebra, in which he traced the historical development of this branch of mathehe traced the hatorical development of this braight of mathematics, beginning with the almost preshitors Egyptian Ahmes, then giving a very full account of the Greek Diophantus, and then giving a very full account of the Greek Diophantus, and then giving the state of the Greek Diophantus, and the Greek Diophantus, and the Greek Diophantus, and the Greek Greek Greek Tessilis The Hindoon, Arya. Bhatta about 00 B C, and Bahama Gupla; 200 A D., were discussed, and were presented as like source of Arabana sighers, and thus of the Papers read before this Section neulade cone on the latitude of the Siyre Observatory, by C L. Doolittic, and on the seculiar variation of terretiral laitudes, by George C Commiscole. The results of the investigations appear to be proof of a secular variation of terretiral laitudes, by George C Commiscole. The results of the investigations appear to be proof of a secular variation of control Pole amounting to about 41 seconds in a Centrely.

century.

Frask H. Bigelow exhibited and described a new aurorancilinometer which will be sent to Alaska this autumn, and
valuable results are expected in the study of the aurora.

One entire session of this and the Physical Section jointly was devoted to an elaborate monograph by A Macfarlane, on principles of the algebra of physics.

SECTION B-Physics

Prof. F. E. Nipher, President of Section B, opened the pro-ceedings with an address on the functions and nature of the ether of space Many reasons formerly given for the existence ether of space Many reasons tormerry given for the extensive of such an ether, he said, no longer exist. For tenerny the state of the s but absent in fact, might be dispensed with in the theory by making its velocity zero, and that this does not involve an unstable condition of the medium, and is therefore admissible The showing up of light in space occupied by matter shows that the ether within must either be more dense (as Fresnel beheved) or less clastic than that existing in free space. It is certainly very difficult to understand what there can be in the molecules of matter which can increase the density of an incompressible medium. The beautiful experiment of Michelson and Morley shows apparently that the ether at the surface of the earth mov with it. It is dragged along as if it were a vivid liquid. The It is a sun which is maintained permanently without the cxpenditure of energy It seems, therefore, that the resistance to shear which shows itself in the adhesion of the ether to the moving earth must be a rigidity due in some way to inotion. Other experiments of Michelson and Morley on the motion of Other experiments of Michelson and Morley on the motion of light in moving columns of water have been taken as proof that the ether in water is condensed to nine sixteenths of its volume in air. The ether in water certainly hehaves us if it were more dense, but it is another matter to say that it is so. It seems im. in air. The ether in water certainiy nenaves wa, in were more dene, but it is another matter to say that it is on. It ceems im probable. It is still a mathematical fiction which overs a gry in our knowledge of the ether. The speaker thought that the experiment should be repeated with water at rest within a tube which should be mounted on elastic supports in a moving rail-The water tube and observer's scat should be rigidly WAY COT connected and swung on dampened spring supports from the top and sides of the car The question to he settled is whether the ether or any part of it is at rest in space, and does it sweep through the interior of bodies which move through it as wind sweeps through the leaves and branches of a tree. This form of sweens through the leaves and branches of a tree the experiment is the one contemplated by Eisenlohr's analysis leading to Fresnel's formula, and it is capable of great variations in the conditions of experiment. It is, however, more difficult and more expensive than the one so well executed by Michelson and

more expensive than the one so well executed by Michelson and Morley. Whatever its results may be, it promises to add greatly to our knowledge of the physics of the other. Prof. E. W. Morley, who has for several years been conduct-ing researches under the auspices of, and with funds supplied by, the Association, read papers describing his method of de-termining the coefficient of expansion by means of interference length as accurately as Fizeau did that of half-inch bars

length as accurately as Fixeau did that of half-inch bars.

C. B Thwing read npaper on colour photography by 1app-mant's process, and exhibited samples which show a tange of

II. A Hazen, of the U.S. Signal Service, discussed the question "Do tornadoes whit?", and gave results of elaborate and careful suddy of tornadoes and of the daw left by them, from which he concludes that the common notion of a whirl in tornadoes is unfounded

SECTION C-Chemistry.

Prof. R. C. Kedrie, of the Agricultural College, Michigan. chose the subject of alchemy for his annual address

Thirty-three papers were read before this Section, and the meeting was characterized by the Secretary of the Section as the most valuable ever held.

the most valuable ever held.

Mr. Morley contributed valuable material to this Section also, in regard to the synthesis of weighed quantities of water from weighed quantities of water from weighed quantities of water from the contribution of the

NO. 1142. VOL. 44

"Biological Functions of the Lecithines" was the title of a paper by Walter Maxwell In a paper presented by Mr. Max-well at the 1850 meeting of the Association, he showed that a vegetable organism, during the initial stages of growth and under the action of the fements operating in germination, possesses the power of taking the phosphorus present in seeds or in soils, as mineral phosphates, separating the phosphorus from the inorganic combination, and causing it to reappear in the young plantlet in an organic form as a lecithine. In brief, own that the lecithine bodies are a medium through which the phosphorus of the mineral kingdom passes over into the vegetable kingdom. In the second part of Mr Maxwell's paper he went on to show that the lecithine bodies, on the other hand, present in the animal kingdom revert to the mineral form under the action of the ferments present in the animal organism. a hen The phosphorus contained in the egg, in the respective a hen The phospherus contained in the egg, in the respective forms of mineral phosphetas and organic phosphetas compounds as ketthines, was determined in the next place, the eggs were noticulated, and the products of incubation were studied it was funul that the phosphorus contained in the natural egg as a lecitabre responsered in the uncubation products a calcium phospherus products and the products of the product as calcium phospherus products and the products are consistent of the products are consistent or the product of the product as calcium phospherus products are consistent or the product of the product of the products of the product o

lecthine respicated in the incusation product as carcium pro-plint, and forming the hone of the chicken. Were adduced to show that the logarithms of the molecular weights of the hydro-carbons have a direct relation to the fusing and bealing points of these which the control of the control of the control of the three which is the control of the control of the control of the three which is the control of the control of the control of the three which is the control of where logarithms exist between changes in physical or chemical

SECTION D-Mechanical Science and Engineering

The President of this Section, and a soften one of the Vice-Presidents of the Association, is 1/rof Thomas Gray, of I ere flaste, Ind., the inventor of a great variety of ingenious apprains, including the seromoscopic and scienograph shown the Association on their excursion to Terre Haute last year, Ilis addiess was a carefully prepared discourse on problems in mathematical science. It was technical in character, and dealt with the teachings of mathematics and physics in their application to engineering

Among the papers before this Section was one on Government timber tests, by B F Permor, Chief of the Bureau of Forestry. timer tests, by her rermor, chief of the backet of referring the said there had been mangurated in the forestry division of the Department of Agriculture a comprehensive states of tests and examinations of American timbers, the ultimate object of which is the solution of a biological problem—namely, to evablish the relation of technical and physical qualities to each other and to conditions of growth. In the pursuit of this investigation, naturally, many questions of immediate practical value in the use of wood for engineering purposes will be solved. the novelty in this enterprise lies mainly in its comprehensivenis and scope. A very large number of lests alone on material of known origin and condition, and an exhaustive examination of the same will permit generalization and the recognition of lives of inter-relation. The work requires the organization of four distinct departments. First, the selection of test material four distinct departments from as many essentially different climatic and soil conditions as from ns many essentially different climinic and value controls as the species may occupy, five fully-instured and two young trees being carefully selected on each site and cut up for test material, secondly, the examination of the structure and playes al condition of the test material, requiring the minutest detail, thirdly, the usual testing with special care, and, lastly, the compilation and with the physical examination and the known conditions of growth. Besides more trustworthy data thin hitherto attainable growin. Besittes more trustworiny data than hinerio atlantable of the qualities of our piningpal timber, there is to be gained from this investigation a knowledge of conditions under which destrable qualities can be produced by the forest grower Prof. J. B. Johnson rend a paper on the United States tests of strength of American woods, made at the Washington University Testing Laboratory, 51 Louis.

SECTION E .- Geology and Geography.

Prof. J. J. Stevenson, of New York, presided His address was on the relations of the Cheming and Catkull on the eastern side of the Applachana Basin. He timed the groups along the eastern outcrop from Tennessee into New York, acrow Southern and Western Pennsylvania, and eastward through Northern Pennsylvania, and Ashburtte in Pennsylvania, and

of Prof Stevenson in Virginia and Pennsylvania, incidentally referring to the work of Profs Hall and Williams in New York. In this way the continuity of the section was shown, and the In this way the continuity of the section was shown, and the magnificance of the variations was insisted upon strongly. An area in South eastern New York and North eastern Pennsylvania, in which the Chemung group is almost without trace of animal or vegetable life through the greater part of the thickness was described. The absence of life was thought to be due, not to fresh water, but to turbidity of the water in a shallow basin near the land The facts that the horizons of shi-reamins are much lower in the column than had been supposed, and that the plant-remains come in like manner from the home group, were thought to be of especial interest and importance. The conclusions to which the specker was led were -(1) That the series from the beginning of the Portage to the end of the series from the beginning of the Portage to the end of the deviced into these problem-ble Yorking, the Chewaung, and the Castkill (2) That the disappearance of animal and vegetable life on to great a pure of this area toward the close of the period was due simply to gradual extension of conditions exiting, perhaps, a certly as the Hamilton period in South-cinesid sea, but that the influx of great rivers with their load of differs made conditions in the shallow basin such that assimal life could not exist. (4) That in the prevent state of our knowledge was zero justified in molating the Cheming period in the ending the Cheming period in the Carboniferous age

the Carboniferous age
Modwithranding the inpending meetings of national and
international Geological Societies, this Section was fully occufifty, and the William Hallock read a paper entitled "A
Frelimmany Report of Observations at the Deep Well, Wheelng, W Va " The question as to the conditions which exist in
the intern of the earth, said Mr Hallock, has always attracted
much attention. The most important factor in the solution of much attention. The most important factor in the sources of this riddle is the determination or estimation of the temperatures there existing. The British Association has for years seized there existing. The British Association has for years seeze every opportunity to obtain data as to the rate at which the every opportunity to onlain data as to the rate at which the temperature increases as the eath creat is penetrated. The temperature increases are the early of the early of the Mr E. Dunker, of Halle, Germany, and were obtained from a 4170 foot well at Sprencherg, no far from Brinn, and a 5740-foot well at Schladabach, near Leptig. These wells are both full of water, the circulation of which ytutaet results or renders full of water, the circulation of which vitates results or renders claborate apparatus indupenshly, and the thermometers must be protected from the pressure. The Wheeling deep well, annk by the Wheeling Development Company, and hy them generously defined to 100 per constructions of the pressure of the protection of t lowered and raised, and depths measured by a steel wire

	TABI	ε I.	
Depth	7 emperature,	Depth	Temperature Fahrenbest
Feet	Degrees	Feet	Degrees
1350	68 75	3125	88 40
1591	70 15	3232	89 75
1592	70 25	3375	92 10
1745	71 70	3482	93 60
1835	72 80	3625	96 10
2125	76 25	3730	97 55
2236	77 40	3875	100 05
2375	79 20	3980	101 75
2486	80 50	4125	104 10
2625	82 20	4200	105.22
2740	83 65	4375	108-40
2740 2875	85 45	4462	. 110 15
2990	86.60	•	
	٠ ١	100	E1 20

NO. 1142, VOL. 44]

to 500 feet, where as oil and social. Practically il its off the framework with on shall. The correlation of the the first of the framework with on the Concern the same which the temperature rates as the bottom is approached can only be temporary, or we should have an unconcernable or improbable state of temperature at comparatively slight depths. The two distinct series of observations combined in Table II. The two distinct series of observations combined in Table II. trustworthy and accurate. Table II gives a comparison of the results at the three great wells: —

	TAI	BLE II.		
Name of well and location	Feet for 1° F Feet	Total Depth Feet	Temperature al top Degrees	Temperatur al boltom Degrees
Sperenberg, near Berlin Schladabach, near	59 2	4170	47 8	118.6
Leipzig Wheeling Develop-	65 o	5740	51.9	135.5
ment Company Top and greatest	_	4500	51.3	110 3
depths Mean of lower 3000	74 3	4500	-	_
feet	75 4	4500		_
Mean of above two	74 9	4500	_	-

Inasmuch as the bottom of the well is some 3700 feet below sea level, it seemed worth while to attempt barometer readings sen ieven, it seemed worth while to attempt barometer readings in it. The instruments used proved ill adapted to the work, and the results were unsatisfactory. Samples of air were taken at the bottom, but could not be analyzed in time for use. A series of observations in a coal mine near the well gave as a very probable value of the temperature of the top invariable stratum. probable value of the temperature of the top invariable stratum 51; 3F. From the mean annual temperature of Marteita and Steubenville it might be taken at 52; 2F. Drilling is temperature of many the resolute. Mr. Auton, Bayman, of the Drelopnent Company, has generously guaranteed half the expense, and what is wanted to that so more one shall furnish the other 3000 dollars, and enable the Wheeling well to be lifted from the second to the first place among the deep wells of the world

SECTION F .- Biology

Prof John M Coulter, President of Indiana State University, gave the annual address, as President of Section F, on the future of systematic bolany. He contended that for the systematis to to day and of the future there must be three distinct lines of work, related to each other in natural sequence in the order presented, and each turning over its completed product to the next. (1) The Collection and Description of Plaints to expressed great gratitude to the noble army of self-denying pioneer collectors, but claimed that the time had now com-when the same amount of labour could be expended to better when the same amount of labour could be expended to better advantage, and that a race of itself workers must be trained who shall follow their profession as distinctly and scientifically as the race of topographers. In reference to the work of description he read an aupublished note of Prof. Ana Gray, in which were incompletent. The speaker also expressed the opinion that the exclasive use of gross organs in the description of higher plants would be given up, and that the more stable minute theracter would prove valuable axis in steadying disgrayments. A diagree in the use of these minute characters was pointed out, ur, the tendency to we a mighe set of minute from to it. The character of a species is an extremely composite not thoroughly equipped great caution in publication." (3) The Construction of a Natural System.—The speaker spoke of the necessary of constructing a natural system with easy advance in the knowledge of affinities, as a coarement summary of information of the state of the consolidation summary as a follows—"The points presented in this consideration of the third phase of systematic bodary are that the last and highest expression of systematic work is the construction of a natural system, based upon the accumulation of those who collect and desembe, and those who study life-histories, that this work involves the completest command of literature and the highest powers of generalization, tempted with every advance in knowledge; and that all the known facts of affinity, thus brought within reach, should be expressed in all systematic literature."

expressed in all systematic interature.

This Section, as usual, was the most crowded of all, forty-seven papers having been read before the Section itself, and many more before its two off-hoots, the Botanical and the Entomological Club. This was another of the Sections which its Secretary considered to have had the most successful meeting. its Secretary considered to have had the most successful meeting on record. A feasure now at every annual senson in the report of the property of the property

SECTION H-Anthropology

The youngest Vice-President at this session, if not the youngest man who ever held a Vice-Presidential office in the American Association, is Prof. Joseph Jastrow, whose age is 28 years His address was enuited. "The Natural History of Analogy" Major J W. Powell, Chief of the U.S. Geological Survey, exhibited and explained his inguistic map of North America, on which he showed the classification of languages of the

on which he showed the classification of languages of the aborigines

Mr Cushing read a paper on the Zuñi Indians, and danced the Messiah dance, which a few months ago was so much talked about, and almost involved a war with the Government

SECTION I - Economic Science and Statistics

Of all the Vice Previousia Saluties and Statistics

Of all the Vice Previousia Saluties, that of Prof Edmand

I all the Vice Previousia Saluties, that of Prof Edmand

I all the Vice Previousia Saluties, and the Vice Previousia Saluties

wilespread popular interest and attention, on account of the

vicin previous I propriate of the theme presented, which was

"The American Farmer his present economic condition and

"The Vicer question was carefully considered, and all who

took part in the discussion agreed in opposing the free coinage

schemes which are now so vehemetry urged upon Congress

The general business of the Association included a change in the constitution, so as to adjust fifty foreign honorary members, and many recommendations to Congress as to forestry, water supply and management, and other topics Preliminary arangements were made to participate in the Columbian World's Fan in 1893 A Committee was appointed to solicit donations for the endowment of the Association with a fund of at least \$100,000 Three hundred and seventy one new members were elected, arrice numbers and seventy one new members were elected, bringing the total membership up to about 2300, which is highwater mark in the hatory of the Association Prof. Joseph Le Conte, of California, was elected President, and the Association adjourned, to meet at Rochester, N.Y., on the third Wendesday of August 1892

RAIN-MAKING IN TEXAS.

THE announcement in the Standard about a fortnight since, that rain had been artificially produced in Texas by exploding oxyhydrogen balloons and dynamite, was probably received by most scientific men with a sus-pension of judgment. The somewhat sensational form of the report, the emphasis with which it dwelt on the unfavourable antecedent conditions, and the omission of all details that might enable us to form some rough estimate of the forces employed and of the resulting effects, seemed calculated to appeal to the barren emotions of astonishment and love of the marvellous rather than to astonishment and love of the marvellous rather than to the sober judgment of well-balanced minds; and but for the fact that the experiments were stated to have been made by the officers of the U.S. Signal Service, which, on the hypothesis of a hoax, would have been a needless on the hypothesis of a nost, would have been a necules challenge to speedy dental, one might have been disposed to regard the story as only an additional instance of a kind of produce for which the Western States are somewhat notorious. The further accounts that have now reached us prove, however, that this is not one of Jonathan's amusing attempts to play off on the cre-dulty of his simple-minded cousins across the Atlantic. Not only have experiments of the kind described been actually made, but they have been apparently successful, and they seem to have been repeated sufficiently often to and they seem to have been repeated sunciently often to render it at least improbable that this success has been entirely fortutous. The improbable features of the Standard's report are, indeed, somewhat toned down, the dryness of the local atmosphere was by no means so great as was to be inferred from the vague language of the Standard's informant, but, as far as can be judged from the notices now before us, it seems unlikely that the rain which followed General Dyrenfurth's experiments would have occurred in the undisturbed course of natural evente

The experiments were made at a place known as Runch C. One writer states that an intermittent series of experiments had been carried out for three weeks, and that "not in a single instance has rain failed to fall within ten or twelve hours after the explosion" But the number of trials is not stated-an omission the more to be regretted, because the improbability that the results are fortuitous increases in a certain geometric ratio of the counts of those made on August 18, 26, and apparently the morning of the 27th, and it is by no means clear that the evidence is not limited to these, although the expression quoted above would seem to imply otherwise The first, that of August 18, was made about 3 p m.

There were at the time a few scattered clouds, but no indication of rain.

The reading of the barometer is not reported, but the relative humidity of the air immediately before the experiments (presumably at the earth's surface) was not more than 60 per cent of saturation. An oxy-hydrogen balloon, the capacity of which is not stated, was exploded by electricity at an altitude of a mile and a quarter. Several kites, with packets of dynamite attached, were sent up immediately after the balloon, and the charges exploded by similar means, and "rendrock powder was distributed for a distance of two and threequarter miles from head-quarters, and fired by igniting dynamos" These explosions "sent up great volumes of white smoke, which rose only a short distance, and was then beaten down by heavy rain, which at once began falling and continued for four hours and twenty minutes" Prof Curus, the meteorologist of the expedition, esti-mates that the rain covered an area of not less than 1000

On August 26 it is stated that "balloons containing several thousand feet of oxyhydrogen gas were sent up and exploded at heights varying from 1000 to 10,000 feet, and at sundown batteries on the ground began their and at sundown batteries on the ground began their work, and until 10 30 pm a constant cannonade was carried on under a sky of perfect clearness, lit by countless stars of a bniliancy seldom seen in the north. The barometer promised fair, and the hygrometer stood between dry and very dry," whatever these expressions may mean. The account continues.—" 4111 pm General Dyrenfurth withdrew his forces, and all retired for the night Sleep, however, was soon interrupted, for at a m. the first return fire flashed from the heavens, when the rain-makers were roused by a crashing peal of thunder, and the rain was soon beating on the roof. At sunrise a magnificent double bow arrhed the heavens, and the downfall of rain did not cease till 8 o'clock a m. A number of heavy charges of dynamite were then made, and after every one the drops again poured down, till at last the clouds were entirely expended."

in these quotations is given all that is essential in the newspaper reports now before us. Although deficient in many details that it would be desirable to know, they are written by one who witnessed what he described, and there seems no reason whatever to doubt their genuineness and good faith, we may therefore, discuss the information they afford, without imagivings of its sub-

stantial trustworthiness.

It is not antecedently improbable that, in certain states of the atmosphere, the liberation of a large amount of heated gas consisting wholly or in great part of water vapour, at an elevation where acrial movements are but little retarded by terrestrial friction, may suffice to generate an ascending current, and elementary physical considerations teach us that a the lower level, will in ascending speedily become saturated and condense its surplus vapour, first as cloud, and eventually as rain, not indeed by acquiring more vapour, but in virtue of dynamic cooling as it progressively expands under the diminished pressure of greater altitudes. But unless the atmospheric strata thus immediately affected be already in a condition of unstable equilibrium, unless the vertical decrease of temperature in these strata is already somewhat greater than the adiabatic rate of decrement, so that the ascending movement once started can be maintained by the store of energy already present in the form of sensible temperature and the latent heat of the included vapour, the effect must of necessity be temporary and local-inore of the nature of a small thunder-storm, or cloud-burst, than of the widely extended or sporadic rainfall that accompanies a baro-

In fact, the possibility of rainfall production depends on the possibility of producing and maintaining an upward movement in the atmosphere. There is always some vapour present in the air, generally sufficient to form clouds when dynamically cooled by an ascent with the state of the production of the production of the production of the production of the ground and warmed by its contact, may be very dry as judged by our feelings and by the evidence of the hydrometer. The amount of energy yielded by any moderate provision of oxyhydrogen balloons and dynamie is but infinitesimal in comparison to the production of the p

It seems highly probable that on August 18 the atmoshere was in this unstable condition. Even in the warm stratum resting on the ground, the humidity was existed at some height, and rain began to fall almost immediately on the conclusion of the explosions. It may be noticed, too, that the time of day was that at which the barometer is lowest and the humidity highest in the cloudties. The strategies of the conclusion of the explosions of the pround surface. In the absence, then, of any observations of the temperature and humidity of the strata primarily stried up by the exploding acilions and dynamite, may be a supplied to the continuous of the continuous of the ascending currents once a few of the continuous to maintain ascending currents once a few of the communicate the disturbance to regions a round. On the 26th, the atmosphere was evidently in a much more mert condition, and four hours elapsed before rain fell, the disturbance being then apparently more local, and of the nature of a thinder-storm. However, with the meagre data as yet before us, it would be premature to attempt any cruical discussion of the processes in opera-

It is needless to say that popular theorizing, on this as on most other physical phenomena, concerns itself chiefly with the things that are most obvious to the senses, but often have little or nothing to do with the process. we find that attention has been fixed on the explosion : and we are told that the idea of breaking clouds by producing a motion in the air, and so destroying the equicoalescence form rain, is not a new one, that it was the custom to keep a cannon in French villages, with which to fire at passing clouds and thus hasten the downpour, that at the battles of Dresden and Waterloo the concussion of the air by the cannonade led to the descent of torrential showers, and we are reminded that "in the same way" rain follows a peal of thunder caused by the passage of a lightning-flash through a moisture-laden atmosphere, &c Now, all this noise and disturbance have no more to do with the production of rainfall than has the thrashing which the village rain-maker of Central India receives from his fellow villagers to stimulate him to fresh exertions when he is thought to have neglected the performance of his official duties, or the London street-boy's whistle, with which Sir Sainuel Baker startled a rain-making king in the Southern Soudan, and which was followed by such a deluge that even the rain-making potentate implored him to arrest the working of the spell. The effect of a concussion, as such, is to produce an instantaneous compression of the air, and a momentary heating in a wave which travels away at the rate of about 1000 feet per second, and 18 incapable of generating any translational movement of the atmosphere, and certainly of promoting condensation. Nor do we know of any recorded observations in support of the idea that it can cause the coalescence of cloud corpuscles into raindrops Neither does the concussion of the air by a thunder-clap stand to the downpour that follows it in the physical relation of cause to effect In this case Sir John Herschel adopts the opinion originally put forward by Eeles, that the order of succession is the reverse of that here assumed, that the formation of the jain-drop is the antecedent phenomenon, and the lightning-flash (and ergo the thunder) the consequent, the electrical discharge ergo me trauncer (no consequent, the electrical discharge being determined by the sudden concentration of the electricity of (say) one thousand corpuscles on the surface of the single resulting rain drop, in which case its intensity would be increased ten-fold What case its intensity would be increased ten-told. What causes the coalescence is still a matter of much obscurity, though some light has been thrown upon it by the ingenious experiment evaluted by Mr. Shel ford Bidwell at the Royal Society's conversazione on May 14, 1800, and described in vol. Min [6] 31) of this pournal. When the shadow of a small [condensing] steam jet was thrown upon a white screen, under ordinary conditions, it was of feeble intensity and of a neutral tint . but when the jet was electrified, the density of the shadow was at once greatly increased, and it assumed a peculiar orange-brown tint. It appeared that electrification promoted the coalescence of the exceedingly minute particles of water contained in the jet, thus forming drops large enough to obstruct the more refrangible rays of light. On this view, then, electrification would appear to be the cause of coalescence, and the electrical discharge the ulterior result; but as yet we know too little of the

This story has probably been fold by Sir Samuel in one of his well-known works on Africa, and is too good to be spoilt by condensation. It is at all events, authentic, the present writer having heard it from his own lipt at a Sinia diamer table.

molecular processes concerned in the formation of a randrop to attempt anything like a complete theory. In conclusion, while we cannot but recognie the high interest of General Dyrenfurth's results, with the imperfect information at present before as we the process of the conclusion of the conclusion of the kind that many of the essential circumstances are scarcely wer recorded, or perhaps even capable of being brought within the limits of observation; and thus the logical conditions of a proved conclusion cannot be fulfilled For instance, it is written to the conditions of a proved conclusion cannot be fulfilled For instance, it is written to the conditions of a proved conclusion cannot be fulfilled standard to the conditions of a proved conclusion cannot be fulfilled. For instance, it is written to the condition of the condit

NOTES

This Permanent Committee of the International Committee of Weight and Measures in now holding its meeting at 8' sees, near Pars. The Committee includes Dr. Toerster (Germany), M. J. Hertrand (France), P. Beonti, Director of the Bureau at Scivres, Mr. H. J. Chaney (Great Britain), Prof. Good, Citaly); Prof. Kimpper (Hungary), Prof. Lang (Austria), Mr. H. de Macedo (Portugal), M. Stas (Belgumi), Prof. Thaden (Swedien); Dr. Wild (Ravius). The Committee has recently loit its President (General Ishalen), and one of the objects of the present meeting to to let at new President, an election which will doubtless fall on thesemor member of the Committee, Dr. Foorster.

THE members of the Heilprin Expedition, who have lately returned from the west coast of Greenland, give an extremely unfavourable account of the position in which they were obliged to leave Lieutenant Peary. His leg was broken in Mclville Bay on July 11 Dr. Hughes, who has recorded in the Philadelphia Press the adventures of the Expedition, describes how the accident happened "While we were going astern for the last time," he says, " to make the butt that forced us through a barrier of ice into comparatively clear water, Lieutenant Peary stepped behind the wheel-house to see how things were going With a crash the rudder struck a piece of ice, and the next instant his leg was crushed between the rudder gearing and the side of the wheel-house He was carried below into the cabin, when an examination showed that his right leg was broken square across just above the knee Everything possible was done for him When he had recovered from the shock, and had thought the matter over, he decided to go on to Whale Sound, trusting that by next spring his leg would be so far mended that he would be shie to accomplish the object of his expedition. His friends thought it would be better for him to return, but they could not help admiring his spirit, and resolved to do everything in their power to further his aim. The shores of Whale Sound proved to be completely blocked with ice, so the Kite steamed north to McCormick Bay, on the northern shore of Murchison Sound, which they reached on July 25. Here a space of about two miles was comparatively clear; and Lieutenant Peary's men went ashore, and reported that the place was well suited for A site was selected on the south shore their head-quarters of McCormick Bay, in latitude 77° 43', and a wooden house erected, which Lieutenant Peary declared to be "substantial

and warm enough." On July 30 the Helprin party had to leave him, which they did with sad forebodings. Mrs. Peary bravely masted on remaining with her humband, and they have are companions. The Leutenant hopes to start in the spring for the unexplored interior of Greenland, but Dr Highes says. "It is the deliberate opinion of all our party—and this opinion is indersed fully by all the officers of the Arize—that unless a relief expedituou in sent to Leutenant Peary next summer, he and his party will never be seen again alwe." It is underful whether the food supply a sufficient, and it is thought most improbable that whates will take them the whole boars, in which they would have to traverse 500 miles of occan "filled with floes and lengty, and often shrouded with fog or swept by terrible storms."

An earthquake of great violence caused immense damage in the Republic of San Salvador on September 9 According to reports sent from the capital of the country to the New York Herald, there had been indications for several days that a seismic disturbance of more than usual power might be expected The volcances of San Salvador, San Miguel, and Izalco had been un usually active, and deep subterranean rumblings with slight carth tremors had been felt At 1 55 a.m., on September 9. the carthonake began in the city of San Salvador with a slight tiemor, which gradually augmented The duration of the first shock was ten seconds, during which time a hightful subterrancan noise was audible in every part of the city While the shock lasted, the earth rose and fell in long waves, and even strong men were unable to keep their feet | I'he walls of houses cracked, and then tottered and fell In the capital alone 40 persons were killed, and 50 or 60 seriously injured. The experience of towns in the country seems to have been still worse Of 320 houses at Comasagua only eigh, remain standing, and the to-s of life there was great Analquito has also been almost completely destroyed, and Cojutepeque, Santa Tecla, San Pedro, and Masahuet were so badly shaken as to be practically ruined It is feared that the earthquake has been even more disastrous than those of 1854 and 1873

15 the Isle of Fayal, among the Azores, several shocks of carbonake were felt on August 27 and 28

MR TUCKWELL writes to us from Loughrigg, Ambleside, that an aurora was seen there on Friday night, September 11 liberach spanned the heavent from south-west to northe-saxt, passing nearly through the zenth li was white, with slight cursactions at its south-west base. It was first seen at 9 p m. it had fided by 10 o'clock

A xxw department of physics and electrical engineering will be begin this assion at the new branch of the Mauchester Technical School in Whitworth Street, where a large well-lighted warehouse is being fitted up of crite purpose. The building will be lighted by electricity, the installation being fitted up with sepecial regard to instruction. For the latter purpose, the electric light installation in the Central School in Prances Street will also be available.

THE Library Association is bolding its annual meeting this week at Nottingham. Mr Robert Harrison, of the London Library, presides. The meeting began yesterday in the large theatre of the Nottingham University College.

THE Industrial Society of Mulhouse has issued a programme of prices which it proposes to give for work done in the year 1891-9a. A copy will be sent to anyone who applies for it to the Secretary of the Society. The prizes are very numerous,

and are to be granted for work of many different kinds in connection with the application of scientific methods to industry.

A CONFERNCE on Confers will be held at Chiswock, in October connection with the Royal Horticultural Society, in October II is hoped that this Conference will not only draw attention to the best of these trees and airube from a garden or landscape point of view, but show what are the best varieties to plant for English-grown timber, as well as the different uses and usitabilities of the various foreign-grown timbers. The co-operation of landowners and others who may have planted these trees or shrubs in years past, or who take a present interest in them, is specially jurited.

DREDERS working in the Tiber to prepare for the construction of a new embankment brought up on September 12 a magnificent ancient Roman bronze helmet. It is perfectly preserved, and is decorated with bas-relefs. Signor Rossi, the Italian archeologist, sasigns it to the second censury before the Chains and Chain of the Chain and Chain of the Chain of the

ACCORDING to the Calcutta correspondent of the Times, it is understood that the Ameer of Cabul is taking steps to obtain from England a geologist, a chemist, two miners, and a number of mechanics.

THE Royal Meteorological Institute of the Netherlands has just issued another nieful work in maritime meteorology, viz "Routes for Steamships between Aden and the Straits of Sunda." A previous edition appeared in 1881, but since that time steam navigation to the Dutch Indies has greatly increased, and con sequently the number of logs received has afforded sufficient materials to allow of a fuller discussion of the outward and homeward routes for each month. Although there is a certain amount of regularity both as regards the monsoons and currents. yet there are considerable differences both in force and direction in the same months of different years, which cannot be taken into account in laying down general routes, but tracks laid down with great care from the most complete data available will give the best chance of successful passages. We cannot enter here into the details of the results, but we may mention that the tables and charts contained in the work show for each 10° of longitude the number of vessels which have cut those mendians in different latitudes, and the means of the number of hours taken. The tracks show that a very considerable divergence from the most direct routes is recommended in certain months, according as the east or west monsoon may be blowing. The usefulness of the work is attested by the fact that copies have been ordered for their vessels by the French, Russian, and Italian Governments

It a expected that us no other department of the "World's Colombus Exposition" will there be a greater diversity of Colombus Exposition will there be a greater diversity of exhibits than in that of mines and mining. Not only will there be a magnificent array of diamoned, opuls, mertald, and other gems, and of the precious metals, but a most extensive collections of truo, copper, feed, and other occus, and of the products; of of truo, copper, feed, and other occus, and of the building stone, of only genits, martile, sandstone, and other building stone, of solis, salt, and peterodeum. A sub department will lake special charge of the coal and iron exhibit, and later of that of copper and lead.

Mr. O. CHANUTF, a well known engineer of Chicago, has been studying the methods of preparing wood demically to resist decay, and has expressed the opinion that great economies might bus realized in America by the general sdoption of these methods on rallways Science says he recently examined some

NO. 1142, VOL. 44]

experimental railroad ties of the most perishable kinds of wood prepared by what is known as the alno-tannin (Wellhouse) process, in St. Louis, in 1881 and 1882, and laid in the tracks of the Atchison, Topeka, and Santa Fe Railroad, at Topeka, Kan , and La Junta, Col. After nine or ten years' exposure they show excellent results, whereas they would have leated but from one to four years if unprepared. Unprepared ties of the same kind of timber, laid at the same time, adjoining to the prepared ties. have all decayed and been taken up, while present supersances indicate that the prepared ties (red oak, black oak, and Colorado pine) are likely to show an average life of ten to fifteen years or more. Mr Chanute calls attention to the fact that the zinctannin process not only preserves ties against decay, but hardens them as well it is found on one railroad that after three years' exposure treated hemlock ties hold the spike as well, and cut less under the rail than untreated white oak.

SOME time ago the Field Naturalists' Club of Victoria organuzed an excursion to the Kent group of islands, the object being to collect specimens, and to determine whether the group is most nearly related with Victoria, to which it is closest geographically, or with Tasmania At the annual conversations of the Club, held recently, Mr. C A Topp, the retiring President, referred to the results of the expedition. The bulk of the fauna and flora was found to be common to Victoria and Tasmania, but there were six or seven varieties of birds peculiar to Tasmania to two peculiar to Victoria. The conclusion was that the islands had been separated from Tasmania after that island was disjoined from the mainland. Among the plants, several forms were found varying somewhat from the typical forms of the same species on the mainland, while it was interesting to find that the arboreal short-eared opossum had changed his habits so far as not to feed on the leaves of the eucalypt, and to keep to the ground

In a paper in the American Engineering Magazine, on ventilation, Mr. Laurence Allen contends that in very many schools the quantity of pure air admitted is not sufficient to expel the foul air To maintain the air in a good sanitary condition in a properly constructed schoolroom, his experience confirms the amount required as stated by Billings, to wit, 60 cubic feet of air for each occupant per minute. For 100 pupils this amounts to 360,000 cubic feet per hour. How many schools come up to this requirement? In the United States, says Mr Allen, there are many schools that contain 100 pupils and do not introduce more than 25,000 feet of pure air per hour, and even that is rendered in a measure ineffective, because the air is not properly admitted. "The pupils do not die in the poisoned atmosphere ; many of them will appear reasonably healthy. So do many persons who visit and tarry in malarial districts. But though the effects are not immediate and striking, they are sure, permanent, and easy to be traced to their causes in after years, by those who make a study of disease and its causes. It is scarcely less humane to kill a child than, by wilfully ignoring sanitary requirements, to cripple it for life, physically, mentally, and morally, as children are being crippled to-day in the vile atmosphere of many schools."

IN a paper published in the current number of the Journal of the Anthropological Society, Mr. J. Latter refers to the great development of the arms and chests of the natives of Fakson's (Bowditch Haind, Union Group). He thinks it may be due to the fact that they are obliged to go about so much in canosa: Si Joseph Litter, who took part in the discussion which followed the resulting of this paper, remarked that he would not have the resulting of this paper, remarked that he would not have lengthening of the arms, although be could maderstand its resulting in moreased size of chest. He pointed out that the natives of Tongs were also accusioned to use canosa, and heppen it was not clear that the phenomenon could be traced to the cause sangend Mr. Later replied that, although the Tongananec canoos, canoo work is not so essential, a part of their lives a nec canoos, canoo work is not so essential, a part of their lives a it is in the case of the natives of Faksofon. The natives of the island of Tongarabh have many avocations quite apart from the set, for they live on an island twenty-two mules long, and many a villages are situated some distance from the water. The natives are villages are situated one distance from the water. The natives of Faksofit, on the other hand, live crowded together on a small islet situated on a ring of reefs, and to meet almost every need of their lives they must do more or less maddling.

MR IVAN PERSOR, the United States special census agent, has been engaged in taking the census of the natives of Nunivak Island, in Behring Ses, in 66° N let. He found the population to consist of over 600 natives. It was previously supprised that over 300 people occupied the usland There are no white men there, and the natives live in a most primitive style. Their only food is the flesh of the walrus, and their only wealth consists of ivery obtained from the tasks of that animal. There are few land otter, but, spart from these, the natives catch no further bearing animal.

Dit 1. Weister Five 1s of opinion that savage races possess the perception of colour to a greater degree than do civilized races. In a lecture lately delivered before the Franklin first text. Philadelphia, he stated that he had past concluded an examination of 250 Indian children, of whom 100 were boys Hind he selected too white boys from vanous parts of the United States, he would have found at least five of them colour blind among the Indian boys he did not discover a sugle case of colour-blindness. Some years ago he examined 250 Indian boys, and found two colour blind, a very low percentage when compared with the whites. Among the Indian girth he did not find any. Considering that only two females in every 1000 among whites are colour blind, he does not think it surprising that he did not find any excomples among the Indian girth.

DR J FRANK lately reported to the Chicago Medical Society the ease of a man who periodically sheds his skin. The shedding began in his first year, and has since then occurred regularly every July. He is taken with feverish tremors, increasing almost to paroxysms He undresses, lies down, and within a few minutes the skin of the chest begins to turn red The redness rapidly extends over the entire skin, and the feversh tremors continue uninterrupted for about twelve hours Then he rises, dresses, and walks about in perfect health. The skin now begins to neel, and ten hours later it comes off in great patches. From the arms and legs it can be peeled off exactly like gloves or stockings. As the old skin comes away, a new epidermis, as soft and nink as a haby's. is revealed This new skin to very sensitive, the patient has to wear softened gloves and moccasins for about a week After the old cuticle has been entirely removed, the finger and toe nails begin to drop off-new nails literally crowding them out Finally, the change is complete, the man has a new skin and a new outfit of nails, and is ready to return to the mines. A lady in Washington County, Nebraska, who is thirty-nine years old, has written to Dr Frank that since 1876 she has had a like experience every second or third year.

This Oreut Seed and Plant Company, San Diego, California, have issued an interesting descriptore hat of Californian trees and flowers. The writer thanks that there is perhaps no country in the world where the early spring flowers so change the face of the early from a desolate waste to a beautiful galedon as on the Padde coast—bills, means, moontains and valleys, and the arid plains of the de ert, alke quickly responding to the viriging rain. "California," he say, "has probably already farmined NO. 1142, VOL. 44]

to the horticulturist a greater variety of beautiful flowers and stately trees than any other State in the Union. Yet many others are awaiting the appreciation of man, or wasting their sweetness on the desert air "

A PAPER on malformations of the bill in brids, by Mr. W. Pyoraft, has been reprinted from the Transactions of the Lecenter Literary and Philotophical Society The most common kinds of malformation are those resulting from overgrowth of the borny sheath, and those arising from injury. Mr. Pyraft discusses these first, and then considers malformation due to embryonic disturbance

""Systoms's British Rainfall, 1890," which has lately been pulshade, contains, we need searcy; say, an enomess mass of information as to the distribution of ruin over the British Isles during the year to which the volume relates Mr Symons points out that the only important alteration in this issue is that due to the completion of the detend 1805-89, which has enabled han to use the average for that period as a basis of commanded to the completion of the detend 1805-89, which has enabled han to use the average for that period as a basis of common soft, and to the details evers as to the reset rain of flut 17.

THE operatives' lecture delivered at the Cardiff meeting of the British Association by Prof. Silvanus P. Thompson has been published by Messrs. E. and F. N. Spon. The subject is "Electricity in Mining."

"THE Hand-book of Januaca for 1891-92" has just been issued. This is the eleventh year of publication. Mr S P Misson and Mr T. Laurence Rockupth have done their best to present the fullest and latest information obtainable, and everyone who has occasion to consult the book will appreciate the care and thoroughness with which their task has been falfilled.

A New edition, revised and enlarged, of the "Alkali Makers" Pirocket-book, "by Prof Dr. Longe and Dr. Harter, will be usued in a few days in Mews Whittaker's Specialists' Series. At the size of the page has been somewhat increased, the designation "Hand-book" has been substituted for "Pockethook". The same publishers are about to issue "A Franciscal Hind-book on the Telephonic, "dealing specially with telephonic exchanges, by Mr. Joseph Poole

Messes Rattrey, I awrence, and Co have issued a second edition, revised and enlarged, of "Simple Recipes for Sixt-room Cookery," by Mrs Buck. True writer produces an excellent impression at once by the sensible tone of the preface, in which the gives some general counsels as to the proper way of dealing with the food of the sick

THE new number of the Journal of the Royal Hortscultural Society contains, besides extracts of proceedings, a number of interesting papers. Mr W Warren writes on Persian cyclamen; the Rev W Wilds on hardy cyclamen, Dr. M T. Mastern, F R S, on germination of ryclamen. Snowlings from the subject of papers by Mr. J. Allen, Mr. D. Melville, and Mr. F W Burbidge There are also papers on the cultivation of hardy bulbs and plants, by Herr Max Lechthia, Lachenaias, by Mr. F W Moore; Cape by Mr. J. O'Mien, and bybund Rhodoleathrous, by Yest.

The volume containing the Proceedings and Transactions of the Royal Society of Canada for 1890 includes papers on the American bison, by Charles Marr, the Vinland of the Northmen, by Sir Daniel Wilson; unit measure of time, by Sandford Fleming; a poculiar form of metallic iron found in Hutonian quartitie on the north show of Sir Joseph Island, Lake Huron, Ontaron, by G. C. Hoffmann; sun-spots observed at McGull Observatory, by C. H. McLeot; a test of Ewing and Mac-Gregor's method of measuring the electric resistance of electrolytes, by J. G. McGregor, the later physiographical geology of the Rocky Mountain region in Casada, by G. M. Dawson; fossil plants from the Simulkameen Valley and other places in the souther interior of Briths Cholmba, by Str. J. W. Dawson

MESSES SWAN SONNENSCHEIN AND CO will issue the following books during the autumn season -"The Colours of Animals," by Prof. Beddard, with coloured and other plates and woodcuts; "Text-book of Embryology Man and Mammals," by Dr. Oscar Hertwig, Professor of Comparative Anatomy in the University of Berlin, translated and edited from the third German edition (with the assistance of the author) by Dr E. L Mark, Professor of Anatomy in Harvard University, with 389 illustrations and 2 coloured plates; "Text-book of Embryology: Invertebrates," by Drs Korschelt and Heider, of the University of Berlin, translated and edited by Dr E L Mark, with several hundred illustrations, "Text-book of Animal Paleontology," by Dr. Thomas Roberts, designed as a supplement to Claus and Sedgwick's "Text book of Zoology," illustrated, "Text-book of Geology," adapted from the work of Dr. Emanuel Kayser, Professor in the University of Marburg, by Philip Lake, of St John's Col lege, Cambridge, with illustrations, "Text-book of Zoology," by Dr. C Claus, of the University of Vienna, and Adam Sedgwick, F.R.S., Vol. II "Mollusca to Man," third edition . "The Geographical Distribution of Disease in England and Wales," by Alfred Haviland, M.D., with several coloured maps, "Introductory Science Text-books"—Additions Introductions to the study of "Physiography," by H. M Hutchinson; "Zoology," by B Lindsay, "Amphioxus," by Dr B Hatschek, of the University of Vienna, and James Tuckey; "Geology," by Dr Edward Aveling, "Physiological Psychology," by Dr. Th Ziehen, of the University of Jena, adapted by Dr Otto Beyer, with 21 figures "Young Collector Series"-Additions "The Telescope," by J W Wilhams, "British Birds," by the Rev, H C. Macpherson, "Flowering Plants," by James Britten, "Grasses," by W Hutchinson, "Fishes," by the Rev. II C Macpherson, "Mammalia," by the Rev. H. C Macpherson

An instrument for optical comparison of transparent liquids, named a liquoscope, has been recently devised by M Sondén. of Stockholm Two hollow prisms holding the liquids are separated by a partition at right angles to the refracting angle. The whole is placed in a vessel filled with glycerine, and which allows of vision in a horizontal direction through plane glass plates. The deflection of the light rays through the prisms is thus compensated. So long as the two liquids have the same optical action, one sees a distant mark (say a black paper strip on a window) as a straight connected line; but its halves are relatively displaced if the liquids have different refractive power. The amount of displacement gives a measure of the difference. the positive or negative nature of which also appears from the direction of displacement The author recommends his apparatus for chemical purposes, especially comparison and testing of fats and oils, analysis of glycerine, &c., and detection of margarine in butter, margarine greatly lowering the index of

HERE HUPPERE has lately pointed out some of the biological bearing of the fact (observed in experiment along with Herr Albrech:) that long light-waves are much more strongly absorbed by water than short ones. If the lower marine animals had, like man, the livelest light preception with yellow rays, and a certain intensity of light were necessary to them, they must live at a less depth than if their visual organs were most strongly

NO: 1142, VOL 44]

affected by short-waved rays Thus, e.g., if they needed as much yellow light as that of the full moon, they could not live deeper than 177 metres (say, 590 feet). Yet they are found at all depths where food, oxygen, and a sustable temperature exist. On the other hand, the existence of plants having chlorophyll depends on light, and we might expect that the distribution of non-parasitic plants would be very limited, which is the case. no plant organisms being found under 200 fathoms. Green plants assimilate best in yellow light, and supposing plants to assimilate in moonlight they would find their limit at the above depth (177 metres). But while yellow is here weakened to 0 0000016 of its brightness, indigo blue has still 0 007829 of its original strength, and the assimilation with blue ravs will be 660 times as strong as with yellow Different coloured marine plants react differently according to the colour of light, and they have accordingly different distribution in depth.

The additions to the Zoological Society's Gardem during the past wesh include two Pinche Monkeys (Midu and sulpus 6 v) from Granda, presented by Mr. J. A. Atken; a. Fallow Deer (Chanas tudigares 28). British, presented by Mr. J. Donkson, a. Penian Gazelle (Gizella subgattivista 9) from Persia, presented by Baron Ferdinand de Rothschald, a. Common Commonan (Phalasecarea cardo), British, two Yellow-browed Bintings (Embersas crusted), a. — Banting (Embersas coulct), two Japanese Green inches (Pringila Sanarathis), ary 1 from Japan, purchased, a Yellow footed Rock Kangaroo (Petrogale vanthojus 9), born in the Gardens

OUR ASTRONOMICAL COLUMN.

THE LINEAR ARRANGEMENT OF STARE.—Although the arrangement of stars in curves has often been noted and studied, little attention has been paid to what is apparently a more arrangement of stars in curves has only parallel and parallel and an arrangement of the start of parallel and the start of the start

WOLF'S PERIODIC COMET.—This object can now be fairly seen by means of a small telescope. It will pass through the Hyades about September 25, and be 3 south of Aldebaran on October 2. The following ephemeris, from one given by Herr

Threen in Astronomische Nachruhten, No 3054, shows that the comet crosses the equator near the end of October .—

	Ephemerus for Be	rkn Midnight	
1891	Right Ascension	Declmation	Brightnes
берс 19	h m s. 4 9 50 40	19 5 590	1 9
		18 17 29 3	91
		17 27 4'4	
,, 23			
,, 2	19 14'09 22 1 58		
11 27		15 40 44 3 14 44 57 2	
2º			
Oct i		13 47 32 4	11 2
	29 19 10	12 48 36 5	
" 3	31 22 56	11 48 166	
,, 7	33 14 86	10 46 39 8	
,, 9		9 43 57 5	
,, 11		8 40 16 9	
11 13	37 42.51	7 35 49 0	120
,, 15		6 30 45 1	
,, 17		5 25 18 0	
,, 19		4 19 38 1	12 I
,, 20	41 0 53	3 13 58 7	
,, 23		2 8 33 2	
,, 25	41 33 30	+ r 3 35 I	120
., 27		- 0 0 47 0	
,, 29	41 24 46	2 6 80	
11 31			
Nov.		3 6 51 3	
., 4	40 0 67	4 5 54 6	
,, 6		5 3 70	. 112
,, 8	38 25 07	5 58 14 5	
,, 10	37 27 44	6 51 66	
12	36 24 07	7 41 33 4	104

at the date of discovery (May 4) The maximum brightness will be reached about October 19

GEOLOGY AT THE BRITISH ASSOCIATION

THE Address of the President of the Coological Section having been devoted to the general questions involved in the origin, association, and working of coal, it was natural that the configuration of the configuration of

the coal exhaustive paper Mr. Togley summarized the chief the bearing on the origin of perturbenism. He pointed out that, while the American oil was mainly derived from Pialecupic Cock, that in Europe and Aua came largely from Secondary beets, and the large Caucasian supply was drawn from rock and the large Caucasian supply was drawn from rock apparent to be, a protest took, generally of sandstone or hime stone, which served as a reservoir and was underiam by or contained beds largely consisting of organic remains, with an impervious cover of shade. In many cases the insention has might be contained beds storing the gas and oil. Such rocks can contain from one-eighth to one-tenth of their bulk of oil. The oil was capable of storing the gas and oil. Such rocks can contain from one-eighth to one-tenth of their bulk of oil. The oil was drawn to the strate by artenian pressure, and so gas was drawn to the strate by artenian pressure, and so gas was drawn to the strate by artenian pressure, and so gas was drawn. Where the rocks were very highly disturbed oil occurred, thanks. Where the rocks were very highly disturbed oil occurred, but not in very great shordance, while gas was rarely found.

but not in very great souncance, waite gas was rarely found Mr Ross, in a paper on the same subject, endeavoured to prove that the oil was mainly generated by the action of solitatine volcanie energy upon beds of innestone, basing his conclusion on the occurrence of hydrocarbon and sulphurous vapours in solitatines, and the constant association of rock sait, follomite, and gypsum with the rocks yielding petroleum. He exhibited equations to show that the action of sulphur dioxide and sulphur retited hydrogen on carbonate of line, with or without water and peroxide of hydrogen, was capable of producing the chylene and maring gas derivatives, and equoted experiencis of Blachot to show that sulphur was formed by similar reactions, arguing that has hydrogen points in the control of the contro

to show that support was normed by similar reactions, arguing that the hydrocarbons must be necessary by-products Sir Archibald Geikie communicated two most important papers on the results of Geological Survey work in the Northwestern Highards One of these papers, relating to the discovery of the Olenellus zone in the North-west Highlands, was as follows :-- "Ever since the Geological Survey began the detailed investigation of the structure of the North-west Highlands of unswigation of the structure of the North-west Highlands or Scotland, the attention of its olineers has been continuously given to the detection of any fossil evidence that would more clearly for the geological horizons of the various vadiementary formations which overfite the Lewissa geness. A large collec-tion of organic remnant has been made from the Durieses time-stone, but it has not yet yielded materials for a satisfactory area graphable and the study of this collection, howstone, but it has not yet yeured materials for a satisfactory stratgraphical correlation. The study of this collection, however, has confirmed and extended Salter's original sagacious inference that the fauna of the Durness limestone shows a marked North American facies, though, according to our prevent terminology, we place this fauna in the Cambrian rather than in the Siluran system Below the Durness Imestone has the dolomitic and calcareous shaly group known as the 'Fucoid dolomitic and calcurous shaly group known as the 'Fucusd' beds,' which, though crowded with worm castings, has hitherto proved singularly deroid of other recognizable organic remains from the control of the control o It was struck with the singularly unaltered character of these shales, and acreed with him that if fossils were to be looked for anywhere among these ancient rocks, they should be found here, and that the food collector, Mr Arthur Macconochie, should be directed to search the locality with great care. The following week this exhaustive search was undertaken, and Mr. Macconochic was soon rewarded by the discovery of a number of fragmentary fossils, among which Mr B N Peach, who was also stationed in the district, recognized what appeared to him to be undoubtedly portions of Olenellus The importance of this discovery being obvious, the search was prosecuted vigorously, until the lossiliferous hand could not be followed sugrousty, until the institutions finant count not be followed further without quarrying operations, which in that remote makes the properties of the grant of the properties of the Geological Survey, who continued the reference to Olembia. More recently Mr. Peach interface the properties of the prop nrined the reference to totendus more recently sir. Feach and Mr Horne, in a renewed examination of the ground, have found, in another thin seam of black shale interleaved in the 'Serpulite grit,' additional pieces of Olmellius, including a fine head-shield with eyes complete. There may be more than one the head-spied with eyes compacts. The specific de-terminations and descriptions will shortly be given by Mr. Peach. The detection of Olenellus among the rocks of the North-west Highlands, and its association with the abundant Salterella of Serpulite grit, afford valuable materials for comparison with the oldest Palæozoic rocks of other regions, particularly of North America. The 'Fucoid beds' and 'Serpulite grit,' of North America. The 'Fucoid beds' and 'Serpalite grit, which intervene between the quartite below and the Durness limestone above, are now demonstrated to belong to the lowest limestone above, are now demonstrated to belong to the lowest part of the Cambrian system. The quartilect are shown to form the arenaceous base of that system, while the Durness insectiones may be Middle or Upper Cambrian. On the other hand, the Torridon sonadisone, which Murchaon placed in the Cambrian series, can now be proved to be of still higher anti-The marked unconformability which intervenes between than the overlying quarisate points to a long interval having elapsed between the deposition of the two discordant formations etapaed between the deposition of the two discordant formations. The Torndon sandstone must therefore be pre-Cambrian Among the 8000 or 10,000 feet of strata in this group of sand-stones and conglomerates, their occur, especially towards the base and the top, bands of grey and dark shale-, so little altered that they may be confidently expected somewhere to yield re-cognizable fossils. Already my colleagues have detected traces of sincelled and some more obscure remains of other organisms.

in these strata. These, the oldest relics of life yet known, have excited a vivid desire in the Geological Survey to discover further and more determinable fossils associated with them in the same primæval resting-place. We shall spare no pains to bring to light all that can be recovered in the North west High-

bring to light all that can be recovered in the North west High-nation of a pre-Combrain fauna. Two control of the Combrain faunal con-laints of the pre-Combrain faunal control of the North west Highland. "For some year past," for of the North west Highland. "For some years past," he remarked, "the officers of the Geological Survey have post much time and labour upon the investigation of the Post much time and labour upon the investigation of the post much time and labour upon the investigation of the post much time and labour upon the investigation of the They have succeeded in showing that it consust mainly of materials which were originally of the nature of enquive ignosis rocks, but which by a long succession of processes present No evidence of anything but such ensures rocks had have acquired ine compresses trincaters whose very more present. No videocc of anything hot such enjuryer tooks had present that the present the present the present that the present that the present that the present that the present the the timestones as the result of some crashing down and re-formation of basic ignous nocks containing lime-silicate. But as they proceeded in their work they encountered various diffi-culties in the acceptation of such a theoretical explanation. In par-ticular, they found that with the mica schi's were associated quarti-schits and graphitic achies; and that the limestone occurred in schits and graphitic achies; and that the limestone occurred in schists and graphitic schists, and that the innestone occurred thick and persistent bands with included minerals like those found in the Eastern Highlands in districts of contact-metamorphism. The microscopic examination of some of these rocks showed them to present close affinities to certain members of the crystalline series of the Lastern and Central Highlands, which can be recognized as consisting mainly of altered sedimentary strata (Dalradian series). Yet the officers of the Survey could not separate these doubtful rocks from the surrounding gness The several materials seemed to pass insensibly into each other in numerous sections, which were examined with great care Within the present month, however, one of the members of the staff, Mr C T Clough, who has been specially engaged in this staff, Mr C T Clough, who has been specially engaged in this investigation, has obtained what may prove to be conclusive averageston, has outsined what may prove to be conclusive submited of graphics chairs core every bedded in an acid mica-shirt, in which, also, thin graphics layers are distributed at intervals of an untoo relea. These rooks are sharply marked microbid to be a submitted of the state of the s evidence on the subject. He has ascertained that the main

to suggest the former existence of piant and animat itte.

The existion on Monday was opened by Sir K S. Ball with
a paper on the cause of an Ice age. The communication
stated that the author had a work in the press dealing with the
question of glacial climates. He had sevoed Herschel's figures,
on which Croll's deductions were based, and discovered an
arithmetical error of considerable consequence. If 63 repretents the number of beat-units received by any hemisphere
statis the number of beat-units received by any hemisphere sents the number of heat-units received by any hesusphere during ammers, its winter receive will be represented by 37. defining ammers, it winter received in 100 february to the position of heat may be received in 100 days or in 105 days, accounting the position of the espinones, producing either a long and cool summer or a short and intensely hot one. The paper day of the position of the winter producing either a long and cool summer or a short and intensely hot one. The paper day of the producing the paper serviced counterbule discussion, in which Frof. Sollas, Frof. Wright (of Oberlin, Obio), Mr. Hall, Dr. Crosskey, Dr. Hock, and many other gleatables took part. Forbes with regard to the glaciation of the Dovreffeld Wherever the basement rock is to be seen, it is glaciated, although moralnie deposits were swept away and redistributed by torrential action at the close of the Glacial period

Prof Wright read a most interesting paper on the Ice age of North America and its connection with the appearance of man in that continent. The glacial deposits, transported from several centres mostly outside the Arctic circle, and the absence some the cutter money dynamics that America cross also the address of the press of of a Polar ice cap, militated against an astronomical, and for a

Other papers read on this dity were one by Dr. Hicks, who produced specimens of boulders from Pembrokeshire, which seemed to him like North Welsh or Irish rocks—his picrite was, however, recognized as an Irish rock by geologists in the room, and in any case a flow of ice down the Irish Sea and over Pembrokeshire seemed to he clearly proved, one by Mr. Ken-dall, on a glacial section at Leven-hulme, Mnnchester, in which he gave evidence from the striation of the subjacent rock, and the intrusion of tongues of boulder clay into it, the transport of fragments, the orientation of large boulders, and the direction of strice, together with a consideration of the levels of the different portions of the rock beneath, that the district had been terent portions of the rock beneath, that the district had been travened by land toe coming from a direction of few degrees from Dailey Dale, near Matlock, which he regarded as having been washed out of rocks skring the valley. In connection with these papers may be mentioned a report by Mr. Harrison, who has excavated in the tails under some rock-shelters at Oldbury take securated in the status under ione for occasionists at Ordally Hill, near [abham, from which he obtained forty nine which finished Falicedithic implements and over 600 waste fakes, which were described in a separate paper by Frof Frestwich. Frof Wright gave also a brief account of the basilist laws beds of the Facilic tosis, which are of post-frestiary age. New evidence in favour of the gestimeters of the Calaveras skull and other human remains found under the law beds was given, and the discovery of a small clay image in a similar position under the western edge of the lava plains of Idaho at Nampa was re corded, the lava beds are correlated with the glacial deposits of

Mr Jones's report on the Elbolton cave, near Skipton, was of unusuat interest. Long-headed human skulls were found with burnt bones and charcoal in the upper stratum, associated with domestic animals and pottery ornamented with diamond and herring hone patterns; while at a much lower level—13-15 feet below the floor-there were round skulls, much more decayed. Delow the floor—there were round skulls, much more decayed, in connection with ruder and thicker pottery than has been found in any other part of the cave. No flints or metal of any kind have been found, and bone pins and other worked bones are the only human implements hitherto discovered. The are the only human implements hitherto discovered. The remains of bear and hare have been found in cave earth below this level, and the investigation is to be continued in the hope that remains similar to those of the Ray Gill fissure may yet be met with

An interesting discussion was raised on the paper by Dr. Hicks on the Silurian and Devonian rocks of Pembrokeshire

and Devon. The Silurian rests transgressively on Ordovician and pre-Cambrian rocks in Pembrokeshire, but is covered by and pre-Cambrian rocks in PembroVeshire, but is covered by a continuous rener su plin in he fold Reil Sandstone and Car-boniferous, similarly the Morte Slates, which the author regards as the oldest rocks of North Devon, and in which he has recently found Linguilla Durssis, are covered by the Devonian and Culim sense of rocks. Mr. Ussher described the occurrence of a volcanie series in the Lower Devonian rocks of Tor Cross, and traced similar disbasic rocks amonest the chloritic series of Prawle Point, the excessive alteration of these rocks being due to the greater nearness to the old resisting rocks of the Channel In this conclusion he was supported by Mr Hunt, who described the occurrence of detrital tournaaling In the Devonian cliffs at the north-east end of Straiton Sands. and compared it with the occurrence of similar material in a quartz-schist west of the Start Lighthouse. Both schists and sandstone contain detrital tournialine, mica, fine grained quartz, and iron

and iron
Several palaeontological papers were contributed Mr
Montagu Browne exhibited teeth, scales, and boncs of Colobodus from Aust, Warchet, and Lencettershire, which seemed
to indicate the identity of Colobodus with Lepidotus, and possibly of Heterolepidotus with Eugnathus, and to give Colo-bodus an extended upward range Mr Buckman gave an account of the Ammonite zones in the Inferior Oolite There is a marked break on the Continent between the Murchtsone and a marked break on the Continent between the Muchtsonse and the Soverbyz zoncy, which appears to be filled up by the zone of Listers concatum in England The Soverbyz zone, however, is absent in England from all localities except Fundity, and Coombe near Sherborne, and the author therefore 'cought and chiamed a grant to open an old quarry at the latter locality, in order to fully investigate the fauna of the Soverbys rone, and its relationship to the concavum and Sauzes zones Mr Storre, of the Cardiff Museum, exhibited a fine series of slides and drawings of Pachytheca and Nematophyeus, and gave a minute description of them , this elicited some discussion, in the course or writen Mr Marray suggested the Mr Merray suggested the before might possibly be the egg of a Cristicent or one of the Corner might possibly to the egg of a Cristicent or one of the Mr Smith Woodward completely incrusted by a Nullipore. Mr Smith Woodward and gave an account of series of Miocene fish-remain from Sardina Other paleonous Donce fish-remain from Sardina Other paleonous Other paleonous Donce in Sardina Other paleonous Other paleo gave an account of a series of Miocene fish-remain from Sar unna Other paisonological papers were one containing a form of the series of the series of the series with the the Lower Keuper building stone of the series with the series and one by Mr. Vine on the Brycono of the Upper Chalk. Mr. B Thompson gave an exhaustive report of the transition bed between the Middle and Upper Lias in Northamptonshire, from which he had obtained a large and valuable series of fossils Mr Newton described the occurrence of *Ammunits purents* in the Northampton sands, near Northampton; and Prof. Hoyes Panton gave an account of a matedon of very large size at Highgate, Ontario, and a mammoth from Shelburne, in the

The occurrence of a strip of Lower Greensand four to five miles long hetween Shaftesbury and Child Okeford, and running parallel to the valley of the Stour, was described by Mr Jukes Browne The same author attempted to explain monoclinal flexure by the recurrence of movement in rocks already faulted, but covered subsequently by unconformable strate; movement along the faults of the older series, under the influence of new pressure, would throw the overlying series into monoclinal folds or faults. The existence of a large area of Kellaways rock, near Bedford, and the extension of Fuller's earth works at

near Dectord, and the extension of Fullers-earth works at Woburn were commented on by Mr Cameron Several of the Committees appointed last year had done good work. The Photograph Committee had obtained over 250 new photographs of geological interest, many of which were exhibited in the Section-room or at one of the sowiers, where also Prof in the Section-room or at one of the source, where also Prol Wright displayed a fine serice of transparencies illustrating the lava and glacial deposits of the United Stotes, and Mr. Stirrup a set of slides of the dolomite district of Languedoc. The Earth-Tremor Committee had been testing a number of record-Earth-fremor Committee had been testing a number of record-ing instruments; Mr. Smith Woodward reported that the lists of type specimens were progressing, and that many large Museums were publishing their own lists of types, Mr. De Rance gave an account of a number of wells in Yorkshire, Lingave an account of a number of wens in toussing, and recognishing, Notts, Cheshire, Shropshire, and Glamorganshire, and Mr. Johnston-Lavis sent a description of the Vesuvian eruption of 1890-91, the chief part of which has already appeared in the columns of NATURE.

RIOLOGY AT THE BRITISH ASSOCIATION

THE papers read at this Section were fully as interesting, though not quite so numerous, as usual. A good deal of time on one day was occupied by a discussion upon animals and plants, but as several of those who took part in the discussion did not wish their remarks to be reported, it has been thought better to leave out this part of the proceedings of Section D. Botanical papers preponderated over zoological, but it was not found necessity to divide the Section into two

sub Sections. sub Sections.

Mr Grenfell read a paper upon the structure of Diatoms, describing pseudopodia in these organisms. The pseudopodia are quite easy to see in such a form as Melostra with even a are quite easy to see in such a form as Metorica with even a comparatively low power. They are very long and stiff, radiating outwards from the periphery, and are apparently non retractile (they were watched for an hour without any movements being observed), the pseudopodia are sometimes nine times the length of the diameter of the Diatom, and are occasionally branched, adjacent Diatoms were sometimes seen to be connected by a fusion of their pseudopodus. It was suggested that the use of the pseudopodus is to keep the plants floating, and to act as a protective cheveux de frese against their These Diatoms were compared to Heliozoa, with en unes These Diatoms were compared to Itelioroa, with which they have evidently not a little resemblance in the form of the pseudopodus Incidentally Mr Gienfell stated that he half found a conting of cellulose upon the green corpuscles of Archema, which were regarded by Jankister as chlorophyll

bodies, and not as symbiotic algre,

Mr Wager described the presence of nuclei in Bacteria, they were met with in a species of Facillus found in water containing

decaying Sproggra a species of matinal touch in water containing decaying Sproggra a paper upon the nephridia of the leech, McMidis. The citated funnels appear to love their connection with the rest of the nephridium, and to perform the function organs for the propulsion of the blood along the channels in

which they he

which they be
The Plymouth 700 logical Station sent a record of work done
Jurnag the last year by the Director and by Mr. Cannagham.
Mr. Calder-root dreaf a paper upon some conformation
Mr. Calder-root dreaf a paper upon some conformation
the conformation of the state of t had already been made towards a satisfactory solution of this difficult problem. Inquiries were also being conducted with regard to the occurrence of anchowes on the south-west coast of Fugiands, and Mr. Cunningham, the Naturalist of the Association, had carried out some inquiries at fishing viations on the south-coast. At present no net small enough in the mesh to apture anchowes were employed, but that fish appeared so often when the ordinary juliciard nets became entangled, as to suggest when the ordinary pulchard nets became entangled, as to suggest that they might be present in considerable quantities. Anchowy nets had, therefore, been constructed, and would be used during the pilchard servon this autumn. An investigation was also being carried on into the condition of the North bea fisheries, which were declared to be rapidly declining. It was proposed to draw up a history of the North Sea trawling grounds, comparing their present condition with their condition some twenty or thirty years ago, when comparatively few boats were at or thirty years ago, when comparatively few boats were at work; to continue, verify, and extend observations as to the average sites at which prime fish, such as soles, turbot, and brill, become sexually mature, and to collect sixistize: as to the surse of all fish captured in the vicinity of the Dogger Bank and the region Jugic to the eastward, so that the number of imma-ture fish annually captured may be estimated. Also to make experiments with beam traval nests of various methos with a view. the size of fish taken Mr Calderwood added that a regular to determine the relation, if any, between the size of mesh and the use of fish lakes Mr. Gliderwood sided that a regular survey of the English Channel had been commenced, not only in station of the second order had been recently established, where observations at 9 c.m. and 9 p.m. would be taken daily by wet and dry bulb theremoetters, bornetters, rana-gauges, and aum.

and dry bulb thermometers, barometers, rain-gauges, and sun-chine-recorders.

Mr. J. T. Cumingham read a paper upon the reproduction of the pilchard. The ovum of this fish, described as such in the Journal of the Association for 1889, was stated by Fouchet

not to belong to the pilchard; Pouchet believed that the pilchard's ovum is not pelagic. The identification of the ovum was shown to be correct by further observations carried out in the Laboratory with the ova obtained from the mature fish Similar results have been obtained by Marion, of Marseilles

senies
Another paper, by the same, dealt with the growth of foodfishes, and their distribution at different ages
(1) Acts of Crowth and Sey of Sexual Mediurity —Numerous
specimens of the flounder (Pl flux) were reared from the larval
shall to the aground of the Plymouth Laboratory Measured state in the aquarium of the Plymouth Laboratory Measured in April, when a year old, they varied from 4 to 19 cm. (about 14 to 74 inches) Specimens obtained in the Catlewater, and known to be not less than a year old, are from 12 to 19 cm in length. None of these captive flounders, nor any taken in the Cattewater, were sexually mature, but, according to Dr Fniton, of the Scottish Fishery Board, sexually mature flounders have been observed which were only 7 inches long. It was concluded, therefore, that (a) the rate of growth varies greatly for different individuals, but its maximum for the first year is 19 cm, or 7½ inches, (b) sexual maturity is not reached till the end of the second year, although the minimum size of sexually mature individuals may be slightly exceeded by some specimens in one year's growth

Sumilar results were obtained for the plaice (Pl platessa) and

Studies results were obtained for the place (F flatten) and the dab (F) insurant-The young of the above-mentioned species (3) Distribution—The poung of the above-mentioned species (3) Distribution—The studies of the second of the studies and G manufact, occur in about first, see the studies and G manufact, occur in about first see the studies and G manufact, occur in a bottom of the studies and G manufact, occur in a studies o do not pass the first year of then lives in shallow water do not pass the first year of then fives in shallow water. Young soles in the larval state occur in total pook at Meyagwey, and young turbol and brill z to 3 cm in length are commonly found young turbol and brill z to 3 cm in length are commonly found with the state of the stat shallow water, and apparently live at depths greater than 10 fathoms. It seems that our commoner and more valuable food fishes do not attain to sexual maturity till the end of their second

fished to not attain to sexial maturity till the end of their second year, that their near at this age is subject to great midwidual variation, and that the young in the first year of growth have a form they not it of view is now being carried on a Plymonth. The distribution of Orytallogolus Wilson was recorded by the same author. It had been found by Collett in the Planting Collett in the carried on the property of the proper waters—one taken by Indina Edwards in a rock pool at sann.
Mr. Holt subsequently dredged a number in 30 fathoms in
Ballinskelligs Bay The species is probably fairly abundant
between 20 and 30 fathoms on smooth sandy ground all along
the British and Irish coasts.

Mr Cunnipham also read a paper upon the larve of the sea crayfish (Philmurus vinicurs), describing most of the stages, and particularly remarking upon the presence of the first maxili-pede in the newly hatched larva, which had been stated by Richer to be absent.

Prof Herdman and Mr. J A Clubb communicated a paper upon the innervation of the epipodial processes of some Nudibranchiate Mollusca. The cerata of the Nudibranchis were regarded by Prof Herdman as being probably epipodial out-

growths.

The question has, however, been raised lately by Pelaeneer and others as to whether the so called epipodia of Molliusca are all homologous structures, and one of the subjects of controversy now is the origin of the nerve supply in various forms, it being and a the origin of the nerve supply in various forms, it being supposed that where the processes are innervated from the plenral ganglia they are pallial in their nature, and where supplied from the pedal ganglia they are to be regarded as quigrowths from the foot.

Consequently it seemed of importance to determine afresh the origin of the nerves supplying the cerata in several different types of Nudbranchiata, especially as the results of former investigations, depending entirely, we believe, upon minute disvestigations, depending entirely, we believe, upon minute dis-section, are puzzling, and to some extent contradictory. We have traced the nerves from the ganglia, by means of serial sec-tions, in representatives of the genera Polycera, Ansula, Tritoma, Dentironolus, and Eolis, with the following results:—

In Polycera quadrilineata the cerebral and pleural ganglis are completely fused to form a cerebro pleural mass. The "epipodial" nerves are foand arising from the ventral and posterior part of this mass (i.e. distinctly from the pleural ganglia), and they run along the sides of the back to supply the

certaial ridges
In Ancula certata the pleural ganglia are fairly distinct from the cerebral
In a specimen cut into about 500 sections we find in the 100th section or so from the anterior end six distinct ganglia (the cerebral, pleural, and pedal pairs) surrounding the cerebrals. A few sections further back, the cerebrals disappear, and then the epipodial nerves are found arising from the pear, and then the epipodial nerves are lound arising from the dorsal edge of the pleural ganglia. The nerves soon turn posteriorly, and then give off their first branches dorsally. These branches enter the mesoderm of the body wall, and can then be traced back through over a hundred sections to the first pair of cerata, which they enter The main nerve passes back to the remaining cerata

to the remaining cerain In Titoma and Dendronolus also the epipodial nerves arise from the pleural ganglia, but in Eolis (or Facchina) coronata we find that the main nerves to the cerain arise distinctly from the and that the main nerves to me certain arise unitarity from the pedal ganglia. We have also traced in the same series of sections the ordinary pedal nerves to the foot proper, so there can be no question as to the nature of the ganglia from which the nerves arise The epipodial nerves spring from about the middle of the pedal ganglion, rather on the dorsal surface, and after a short course, pass through the miscular layer of the body wall and are distributed to the clumps of ceraia

But, in addition to these main epipodial nerves in Eclis, we find also a nerve arising from the compound ganglionic mass, immediately ventral to the eye (probably, therefore, from the pleural element), which goes to the front cerata. This pleural nerve has its origin distinctly anterior to the origin of the main epipodial nerves from the pedal ganglia

We arrive, then, at the curious result that the innervation of the entry tree, at me curious result that the innervation of the entry tree is the entry tree in the e visible nerves from the pletrait. In the ordinary Rhippide glossate Custroped, und as Trecken, the eppodard radges and processes are supplied, according to Pelenere, by nerves arrange meaning to the choice of the pleaf gangla, So, pademon from the area to the choice of the pleaf gangla, or from the area of the choice of Father as pelad in there nature, and homologous with the eppodal efforces so I I rich site, which twose of Janeda and the rest are totally distinct structures of pullud origin. But these down clared processes in the various Nutritionals are so much alike in their relations, and are connected by such series of gradations, that it is difficult to believe that they are not all homologous, and the presence of the accessory epipodial nerve in arising from the pleural ganglion suggests the possibility of another explanation, viz that these outgrowths, starting at first as pedal structures innervated by nerves from the pedal ganglia, niay have acquired, possibly as the result of having moved further up the sides of the body, a supplementary nerve supply from the adjacent integumentary nerves arising from the pleural ganglia, and this supplementary supply, while remaining subordinary in Eolis, may in the other types have gradually

subordinary in Zotts, may in the other types have gradually come to supplant the original cipyloidal nerves, which are now no longer found in such forms as Polycera and Ancula. This is a present only a suggestion, which may be disproved or supplant of the common than the casimisation of the nerves of a number of additional No. Parker read a paper containing the results of some experiments on respiration in the tadpoles of the common fore,. After referring to the great power of adaptation to external conditions seen amongst amphibious larves, the author conditions seen amongst amphibious larves, the author described some experiments on for gradpoles, which, thhough no described some experiments on for gradpoles, which the complex of the supplements of the common forestimal parts. In tadpole measuring more than a can.

in length—the gills are no longer sufficient for purposes of re spiration, and the animals die in a very short time if prevented from coming to the surface to breathe (2) If tadpoles are prevented from using their lungs from an earlier stage onwards, the gills remain perfectly functional, and development proceeds as usual. At metamorphosis, the fore-limbs are slow in become as usual. At metamorphosis, the fore-times are slow in become ing free, owing to the retention of the operation, that on the same side as the spiracle appearing first. Eventually, a slit like same sade as the spiracie appearing first. Eventually, a slit like spiracie is present on either side. In respiration, the mouth is opened and closed, as in the tadpole. Specimens of branchiate frogs were exhibited, in which the tail had shrunk to less than half its original length.

Exhibition of, and remarks upon, some young specimens of *Echidna aculeata*, by Prof W N. Parkei The specimens are from the collection of the late Prof W K Parker, cimens are from the collection of the late Prof W K Parker, who received them from Dr. E. P. Ramas, Curaiu or feet, who received them from Dr. E. P. Ramas, Curaiu or feet, the restral vide, the anous pointing betekwards, and the rot, the veetral vide, the anous pointing betekwards, and the rot, in the older of the two stages, forwards The youngers stage measures along the dorsal curve, from the end of the snost to the tip of the tail, 12 cm., the greatest diameter of the body being 3 cm., the corresponding measurements of the older stage are respectively 21 5 cm and 6 cm. In the latter, the body is covered with short scattered birsiles. In both stages the shout is very similar in form to that of Orinthockins, and is covered by a thick horny layer, but in other respects the specialization characteristic of Lehidna is already apparent The gape is narrow, and extends only a short distance down The gape is narrow, and extends only a snort divance own-the snow, and the manue, even in the younger stage, is already much larger and stronger than the pes. The tail is short and conical. There is no caruncle, or "egg-breaker," in the snout, such as is seen in Orntho hymotus. A few points in the structure of the fore part of the head in the older stige were described The mouth has the narrow and tubular form seen in the adult, and the long tongue has a horny tip The glands in relation with the mouth and nose are very numerous There is no trace of any teeth-rudiments, and in many other respects the structure of the head shows extreme specialization Jacobson's organ is large, and highly developed A well-marked "turis present in it

Prof Howes read a paper upon the classification of fishes by their reproductive organs. On comparison of the mino gental organs of those Osteichthyes having a non abbreviated kidney with the same organs of the higher Vertebrata and the Elasmobranchs, the female gental duct and the kidney are seen to be orances, the temale genital duct and the kidney are seen to be inversely proportionate in length. No feature more fully characterizes the development of the Mulletian duct than the ac-companying abbreviation of the kidney and the disappearance of its head segment. The persistence of the last named among the Osteichthyes, and its possible retention of the renal function in rare cases, taken in conjunction with the mode of development of the ovary duct in these fishes, point to the conclusion that the latter is in no way homologous with the Mullerian duct as ordinarily understood Balfour's belief that the genit il ducts as ordinarily understood Dallour's nellet that the gent it ducts are homologous in both sexes of the Teleosteans, is supported by the facts of anatomy, and comparison of the reproductive system of the Gancids with thu of the Teleosteans shows the two to be modifications of the same common type, and the absolute structural community of the parts in the males and females of the Sturiones, while further confirming Bal four's doctrine, is opposed to Jungersen's implication that the subtle differences in the mode of development of the ducts in the opposite sexes of the Teleotter, are indicative of their non-homology. The facts above alluded to justify us in their non-homology increases above and entry us in regarding the genital ducts of the Osteichthyes, not only as homologous in the two sexes, and primarily independent of the genital glands, but as distinct structures in general, probably unrepresented in all other Vertebrates. The Plagiostomi and Holocephali, in which vasa efferentia are present and the kidney becomes an accessory to reproduction in the male, may be grouped together into a Nephrorchidic Series, as distinguished from an Enthorchidic Series, embracing the Canoids and Teleosteans. Comparison of the port genitales in relation to the parts of the females of those Teleoster destitute of genital ducts, parts of the females of those Leleosic destitute of gential ducts, especially in consideration of the facts concerning the development of the parts recorded by Scott, Liszt, and others, supports Rathkie's conclusion that the ancestors of the former fishes must have possessed gential ducts the Catechthyes, sithough specialized in respect to many features of their organizations, have,

together with the Marsipolaranchs, retained the least modified type of unnogenital organs known for fiving Vertebrates. W Parker's recent and important discovery that, while in Protopterus a Mullerian duct is present, vasa efferentia are absent, and the testicular products are discharged through a duct ansent, and the testicular products are discharged through a duct more nearly comparable to that of the bony fishes than to the gential ducts of any other Vertebrates, suggests that the deve-lopment of vasa efferentia and the assumption of a genital func-tion by the Wolfman duct, may have been effected subsequently to the formation of the Mullerian oviduct And further comparsion of the Dipnor with the Elasmobranchii suggests that the former may have struck off from the Holocephalic branch of the latter before the differentiation of the ancestors of its living me mhere

Another paper by Prof Howes dealt with the customary methods of describing the gills of fishes. The gills of Plantostomes and Marsipobranchs are not unfrequently enumerated in relation to the opposite walls of the visceral sacs which give origin to them, while those of the higher fishes are enumerated In telation to the opposite faces of the septa which bear them. The confusion arising out of this is well known to teachers, and is, in itself, sufficient to justify the introduction of a revised nomenclature for the parts concerned The facts of develop-ment show (1) [on the assumption that the mandibular or month cavity is serially homologous with a pair of post-oral visceral elefts] that cach gill lies in front of its corresponding visceral eletis) that the saccular type of gill met with in the Maisipobranchs and Plagiostomes is that from which the pecinnte one of the higher gnathostomatous fishes has been derived, and (3) that a mandibular gill has no existence in hving fishes and (3) that a mandibular gill has no existence in living fishes fulls of the Marsipohinuch-Plagiostome type may be conve-nently described for general anatomical purposes, as Cytin-branchia, and those of the higher Telosteout type, as Petitin-branchia, while the parts of the individual gills themselves should be in all cases enumerated in relation to the visceral should be in all cases enumerated in relation to the viscerial pseudost from which they are. I has, the spiracular gill of Lisamobianch folders termed the mandibility pseudostanching [1] of the higher fishes (often termed the hyord pseudobranch) as the first hranchial hemilitanch. The well known screes of hoccal filaments met with its certain. Chelonia appear to have noccal manners met with its certain Chetoma appear to nave we fit the fundamental relutionships of gill flows, and, in view of the appear, from its mode of development in the Telesate, to be the morphological equivalent of a pair of gill pouches, the possibility that these filaments may fit any rate for the most party represent mandhular gills of inversional character must not be overlooked

Dr Arthur Robinson communicated some facts relative to the development of the rat and the mouse. The most important put of the paper dealt with the relation of the yolk sac to the part or one paper dealt with the relation of the yolk sac to the maternal tissues. The crypt in the uterine wall which lodges the own hecomes shut off from the rest of the cavity of the uterus by a fusion between the distal proximal walls of the sterus. The greater part of the space so formed is occupied by the own, the renaming portions are converted in occupied by the own, the renaming portions are converted into material blood sinuses, the blood in these sinuses baths the trophoblast and the distal end of the yolk sac. Later, the distal part of the yolk cavity is obliterated by the apposition of its walls, but the proximal portion remains, diretticula grow out from from this into the placenta, which inauntain the intimate relation of the solk sac to the maternal blood It seems probable, in view of these facts, that the yolk sac plays an important part in the nutrition of the fectis. The allant is is a solid mass of meso blast containing no diversiculum from the elimentary tract, and does not become attached to the trophoblast until comparatively

does not become attached to the trophosomer and companions, late in the life of the embryo, i.e. the eleventh day

Another paper by the same was entitled "Observations upon the Development of the Spinal Cord in Min minimum and Min.

The control of the Spinal Cord in Min minimum and Min. decumanus the Formation of the Septa and the Fissures accuments the Formation of the copy has and the Fishers." The anictron and posterior septs of the cord west saled to be formed by the spongoblasts of the cord stelf, and not by ingrowths of the enveloping shealth of pia mater. Prof. Marcus Hartog communicated an outline classification of sexual and alluel modes of protoplasmic repuvenescence.

- I The following modes of rejuvenescence occur in cellular and in certain apocytial organisms -
- A. PLASTOGAMY the fusion of evtoplasta into a plasmodium. the nuclei remaining free

- B. KARYOGAMY · the union of cells (gametes), cytoplast to cytoplast and nucleus to nucleus, to form a 1-nucleate cell, the zygote The following variations occur:
- I ISOGAMY. The union of gametes undistinguishable in size, form, and behaviour; this may vary as follows -
 - (a) Mill TiPLE · between several gametes (up
 - (4) BINARY + between a pair of gameles :
 - or, from another point of view-
 - (c) Indifferent between any gametes of
 - the species (d) Exogamous, between gametes of dis-
 - tinct broods only
 (c) Endogamous between gametes of the same brood only
 - ANISOGAMY · the union of two gametes differing
 chiefly in size, the smaller (mero) gamete is
 male, the larger (mega-) gamete, female.
 HYPERAINSHAMY: the female gamete, at first
 active, comes to rest before fusion with the inale
 - OGGAMY: the female is never actively motile, the male is termed a spermalosoon, the female an nosthere

From another point of view karvogamy is-

- 5 ZOOIDIGGAMOUS one gamete at least is actively
- motile (flagellate, ciliate, or amosboid)
 6 SiPHONOGAMOUS karyogamy is effected by a
 tubular outgrowth from one or both of the gametes
- II In apocytial fungi multinucleated masses of protoplasm (gametoids) may conjugate to form a zygotoid, by a siphono gamous process. The union may be trogamous or anisogumous.
 - III. Gametes may be classified as follows -
 - A According to their formation-
 - I EUSCHIST . formed by repeated complete divisions from a parent cell, the gametogonium

 - (a) EUTHYSCHIST each nuclear division is accompanied by cell division (b) Bradyschist the nuclear divisions are completed before any cell division takes place
 - (c) Isuschist . the brood-cells of a gametogonium are all equal and functional,

 (d) Anisoschisi the brood cells are unequal
 - some of them being reduced to aborted or degraded gametes

 - 2. HEMISCHIST: the divisions are limited to the nucleus, none occurring in the cytoplasm.

 3. APOSCHIST: the cell divisions do not occur, but a cell directly assumes the behaviour of a
 - gamete
 4. SYMPHYTIC: the gameto nucleus is formed by the fusion of several nuclei
 - B According to their behaviour, as-

 - FACULTATIVE: retaining the power of development if karyogamy fails to occur
 OBLIGATORY: with no power of independent development.
- 1 Va. PARAGENESIS will include the following modes, usually grouped ander the term parthenogenesis, apogamy (pro parte), &c 20
 - A TRUE PARTHENOGENESIS: the direct development of a
 - facultative gamete without karyogamy (1) Isogametes; (2) Anisogametes (male and female);
 - (3) Oogametes. NO. 1142, VOL. 44]

- B. SIMULATED PARTHENOGENESIS -
 - I CELIULAR: a cell assumes directly the behaviour
 - of a rygote.

 APOCY FIAL a multinucleate mass of protoplasm assumes directly the behaviour of a zygotoid.
- C METAGAMETAL REJUVENESCENCE :-
 - 1 UNICFLULAR: a single cell in the neighbourhood of the gamete assumes the form and behaviour of the zygote.
 - 2. MULTICELLULAR · a mass of cells in the position where gametes should be produced, assumes the character of the young organism formed by the zygote
- D PARAGAMY or ENDOKARYOGAMY · vegetative or gametal nuclei lying in a continuous mass of cytoplasm fuse to form a zygote nucleus
 - 1 Progamic paragamy, the fusing nuclei are the normal gametonuclei of the progamous cell (ovum which has formed 1-polar body)
 - 2. Apocytial paragamy the vegetative nuclei of an apocytium fuse to form a zygote nucleus.

The President of the Section read a paper by himself and Miss Dorothea Pertz, on the artificial production of rhythm in plants. The apparatus, devised by the Cambridge Scientific Instrupiants, aneapparatus, devised by the Cambridge Scientific Instru-ment Company, was exhibited. The plant is subjected to a subject of a less of alternate and opposite influences from light or gravitation, as the case may be The plant to be experimented with it fixed to a spindle, which, by a clockwork escapement, makers a sudden semi-reduction every half hour. When the clockwork staded semi-revolution every hall hour. When the clockwork is stopped, the plant continues to curve with an acquired rhythm; as if the machinery were still in action. This is similar to certain natural rhythms—for instance, to the "sleep" of flowers, which for a short time continue to open and shut although kept

onstantly in the dark

Prof Green read a paper on the occurrence of disatase in
pollen The starch in the pollen grain serves as nutriment for
the growing pollen tube, and the presence of the ferment
converting it into sugar enables it to travel along the growing tube

Prof Vines, in a paper upon diastase in foliage leaves, con-troverts the opinion of Prof Wortmann, who stated that diastase was either absent from the foliage leaves of plants, or present in such minute quantities that it could be of no physiological im-portance. It is this distastes, and not the protoplasm of the cells, which converts the starch accumulated in the leaves into sugar.

Canon Tristram exhibited and made remarks upon the smallest known species of parrot, of which the skin measured only two inches in length.

THE CONGRESS OF HYGIENE

WE printed on August 20 (p. 303) an account of some of the work done in the Section of Preventive Medicine in the Congress of Hygiene The following 11 the conclusion of our

A COROTICA

Sir Dyce Duckworth, of London, opened a discussion on "The Relation of Alcobolism to Public Health and the The Relation of Alcobolism to Public Health and the Prof. Health Wastergaard, of Openhager, followed with a paper on the same subject. What are the losses of life, he saked, caused to a population by intempenace? This question can to a certain extent be answered by examining the causes of death, in the same of the cause of th objected that these causes of death supply an unsatisfactory picture of druking excess, because the wish to spare the feelings picture of annixing excess, occases the wish to spare the teetings of surviving relatives maker returns of such detable less tristi-worthy, and it has therefore been proposed to use other diseases as a measure—such as liver diseases (especially circhess of the liver). Yet it is worth while to examine the above-mentioned causes of death. In most countries the satistices of the cause of death do not allow conclusions with regard to alcoholism corre-sponding to those for Denmark and Norway. But, at all

events, the statistical data sufficiently show that a great part of the civilized world is suffering greatly from the effects of alco-holism. The investigations of the Harveian Society make it tolishis. Like introduction to the Christian Society Make and analysis and females) is directly or indirectly due to the consequences of alcohole excess. The mortality in England from alcoholism in 1871-80 among males 23 to 65 years old was about 1 per cent of all desthan-nearly 800 yearly. What an amount of represented by these 800 destalt 1. In ledguen the yearly loss of life from delinum tremens among males was 330 in 1870-89 Still greater have been the devastations of drinking in Switzerland Prusias has a yearly loss of 100 males from delinum could be had, that chronic alcoholism and delirum tremens alone kill many thousands of men every year. What is to do done? High excess are generally looked upon as an excellent weapon against alcoholism. But we must not forget be done? High excess are generally looked upon as an excellent weapon against alcoholism. But we must not forget properties of the state of the stat probable that in London one-seventh of all adult deaths (males iong as the number of public-houses it so exceedingly inage as in this country. If a person has to go a long way to get drunk, and if he has in addition to pay a good sum for it, he will stop to think before going. Still, high access seem to have some effect, the Verman law of 1887 has, for instance, reduced the con-sumption of spirits to a certain extent. But generally the reduction of the consumed quantity does not seem to correspond with the increase of the excess. An interesting expellent is to new State monopoly in Switzerland. Ten per cent of the surplus are left to the cantons for counteracting alcoholism. regulating the price the monopoly acts like an excise, and the Government takes care that only unadulterated liquors are sold The monopoly is reported to have had a good sanitary effect, and it has caused some decrease in the consamption of liquors. In connection with excise and duties every effort is to be commended which tends to render the access to intoxicating liquors more difficult. Among these measures, the three popular American systems deserve our attention—viz the Maine laws, American systems deserve our attention—viz the Maine laws, local option, and the high-inence system the first of these expedients—the prohibitory system—has been tirted in Maine and some other American States According to this system, it is prohibited to manufacture and sell intoxicating liquors, the only exception commonly being that liquors of "foreign production" may be impurited and sold in the original packages. But this exception is unjust, permitting the man who can afford it to order as much inquere as he inkes, and nearly air reports agree in testifying to the perpetual violation of these law. One curious fact from Maine, where the system was adopted in 1851 may be mentioned During the years 1867–86, 8412 divorces of marriages took place, being profinably several per cent of the yearly number of celebrated marriage. Of these no less than years number of cereorated marriages. Of these to less than 960, or 11 per cent, were caused by intemperance, combined or not with other causes. It thus seems that intemperate habits are rather frequent in this State. Curiously enough, the State of Massachusetts (where there is a considerable revenue for of Massachusetts (where there is a consucrable revenue for licences) shows, under nearly the same proportion—viz 1654 out of 9853. It seems impossible to suppress the liquor traffic in the larger towns. Between the Maine laws and the in the larger towns. Between the Maine laws and the high-incence system is an intermediate system—local option. According to this, it is left to the citizens of a village of the control of the citizens of a village of the citizens of the to a sereptitions lipnor traffic. The third system—high licences—has been introduced in several States Under this system licences for the sale of liquors can be taken out, but the fees are to considerable for instance, too or 100 olollary serably that many small saloom disappear. In some cases the sale of liquors many small saloom disappear. In some cases the sale of liquors many small saloom, the sale of the sale of liquors and the sale of the sale of liquors and the sale of the sale of liquors and the sale of the s

limit the numbers of lucroes that may be taken out. This is the case with the Dutch has of 1881. Still more effective have been the efforts in Sweden, Norway, and Krisland. The numbers of hars have been gradually greatly reduced, especially in the rand districts; and in most of the towns the so-called. "Gothern and the control of the towns the so-called "Gothern and Control of the control of the towns the so-called the Gothern and Sacd rate of interest to the shareholders, the simple and the same and the sa

hr Isambard Owen, of London, said he took part in the docuseous noisy to correct the numerous misquisation current decessions only to correct the numerous misquisation current the first his Medical Association," of which Report he was the said been quoted apart from the context in such a manner so that the context in such a manner so of the Report, he longevity of abstancers (fill below that, not only of moderate deniheer, but even of the decidedly interperate The conclusions of the Report, as far as concerned the habitual invludence in alcoholic liquors, beyond the most moderate amounts, has a distinct tendency to shorten life, the average shortening being roughly proportional to the degree of the properties of the proportion of the properties of the proper

prote the body towards the attacks of disease generally than to miduce any special pathological lesion

M. Milliet, of Berne, Dr. Norman Kerr, of London, Mr. J. Phillips, of London, Sir V Barragion, L. C. G. Dr. Robinson, of Mance, U.S. A., Sir Joseph Fayrer, Prof. E. Alglave, of Paris, Dr. Kinkead, of Galway, Dr. Arthur, of London, Prof. Bohmert, of Dersden, and Dr. Sonsino, of Pisa, alto took part in the disease.

On Thunday afternoon, Dr. W. O. Pricatley read a paper "On the Improved Hypener. Condition of Materiaty Hospitals," of which the following is an abstract — During the end of the last century and the first half of the present one, the mortality in materiaty hospitals was very large, both on the Continent and in Great Britain: According to Le

During the end of the last century and the first half of the special cost, the mortality in materially hospitals was very large, special cost, the mortality in materially hospitals was very large, special cost, and the cut of \$2 \text{ per roco}, while, according to Miss Per 1000, equal to 1 in 132. The cause of the increased mortality in lyng-in hospitals was the prevalence in these most continuous proposition of the cost of the cost

results. Hence it came to be recognized that, by preventing the ingress of these germs to the bodies of puerperal patients, compartive safety, even in lying-in hospitals, was attainable; and the introduction of the anusepite and aseptic methods has produced not only a remarkable diminiution of mortality, but also of duced not only a remarkable diminution of mortality, but also of the morbidity or illness undent to the puerpent slate. A short of the morbidity or illness undent to the puerpent slate. A short countries to lawure the greater safety of patients in maternity hospitals, and of the results obtained in Europe and not United States. The results were very artiking, and were attributable to the control of the country of the countries of the con-trol of the countries of the countries of the countries of the restatent, although other improvements are not has ught of in concluding the citild attention to an interesting table in which were thrown together the statistics of material deaths in six lying in hospitals, situated in various countries, since the introduction of aseptic or antiseptic methods. With these he had contrasted the figures of M. Le Fort before the era of antiseptics, and Mr Newbatt, the distinguished President of the Statistical Society, had kindly computed for him the difference in the proportion of deaths in the two cases —

Mortality in Materially Hospitals from all Causes in various

	BEFORE THE I	NTRODUCTION OF	ANTISEPT	ics.
		Deliveries	Deaths	Per 1000
Total		888,312	30,394	34 21
	AFTER THE IS	TROPUCTION OF	ASTISETI	CS.
	Date	Delivenes	Deaths	Deaths which would have occurred on basis of Le Fort's figures
Vienna	1881-4	15,070	106	516
Dresden	1883-7	5,508	57	188
Russia	, 1886-9		200	2,622
New York	1884-6	1,010	15	66
Boston	1883 6	1,233	27	42
General Ly Hospital				
don	1886-9	2,585	16	88
Tota	ı	102,961	5111	3,522

Number of lives saved out of the 102,961 since the introduction of antiscotics-

Dr Priestley said it would be seen that while, according to M Le Fort, the maternal deaths in European lying in hospitals were 34 21 per 1000 under the old regime, the mortality is now reduced to somewhat less than 5 per 1000. This computation, put in another way, indicates that if the former rate of mor tality had been maintained 3522 maternal deaths might have been expected; the actual deaths were only 511 In other words, 3011 lives of mothers were saved as the result of new and words, 3011 lives of monters were saved as the result of new and purely scientific methods of treatment. This, he thought, might fairly be stated to be one of the most striking trainiphs of preventive medicine. If was no mean achievement to rescue from death more than 3000 lives of women in the acme of their multirity, and when their lives were most valuable to their families

Isamines

Dr. Graily Hewltt, of London, Mr F. Fowke, of London,
and Dr. Leduc, of Nantes, apoke on the subject.
A paper was read by Dr. J C van Dooremal, of The Hague,
on "La Prévention de la Cécité professionnelle."

on "Le Prévention de la Cécté professionnelle "
Dr. Sitley, of London, read apper on "The Prevention of
the Spread of Epidemic Indianna."
And Dr. Fichic role part in the discussion
Greege Parts and Dr. Fichic role part in the discussion
Greege Parts and Dr. Fichic role part in the discussion
Greege Parts and Dr. Fichic role paper on "The Indiance of
the Nide on Mortality in Egypt,"
Dr. Felkin, Of Edinburgh, read a paper entitled "Observations on Malaris and Enteric Fever in Central Africa, and
the possible Antagosius between Mairria and Phibliss,"

4'361 per 1000 NO. 1142, VOL. 447

Inspector General Lawson and Mr. Weaver spoke on this

Dr Lewis Sambon, delegate of the Municipality of Naples Dr. Lewis Sambon, delegate of the Municipanity or sapies, read a paper on "Measures adopted for the Prevention of Infectious Diseases and their Relation to our Knowledge of Epidemics." He first pointed out the similarity, which is most striking, between the mode of development and diffusion of infectious diseases and some insect petits, such as locusti for infectious diseases and some insect petits, such as locusts for instance. Both have likewise their endemts areas, both their seasons of development, both in some years spread more widely, and at long intervals give rise to regular plague; both migrate in the same constant direction, and both die away out of their endemic areas, substiding in the sirrugel for like. He said that the diffusion of species by currents and winds will make us understand the peculiarities in the spread of infectious diseases, which had given rise, in all time, to the most strange theories. The influence of almosphere has been very little studied in conthe registration of the prevailing lower winds during an epidemic, but serious bacteriological researches in the sinking sediment of the atmosphere and in meteoric waters of animals being carried by regular winds or wind-storms far beyond the limits of their homes are universally known Invests of all kinds are often caught hundreds of miles from the In-sects of all kinds are often caught hundreds of miles from the nearest land, out on the high seas. North American birds not unfrequently are carried across the Atlanic to Seotland Far more important is the influence of winds and currents in the distribution of microseopic animals. These minute organisms or their germs, generally adhering to other larger elements of dust, are ruised and carried by the wind until they are allowed to sink again to the soul when the air is in stillness. About quarantine Dr Saml on said that not only our modern investigations proved them useless, but that a long experience has utterly condemned them. England has been accused of has utterly condemned them. England has been accused of being commercially and politically interested in the abolition of quarantine, and this preconception has unfortunately prevented have promoted their opposition to quarantine. No nation can loost of having held public health so high shove commercial interest, and we must also remember that the English, at one Ouarantine was first instituted by the old republic of Venice, Quarantine was first institution by the one republic of Ventice, whose life and power lay entirely in commence; and Dr. hambon said that, although it had proved so disastrous to finance, so useles to anniation, and so ventious to libetty, he was proud that they were a glory of his country. Dr. Sambon concluded that the most important and pechagin the only statisfactory means against infectious diseases was the entirely of the property of the contraction. sanitation of towns and the hygiene of men In speaking of the sanitation of towns he said how vast areas of the old city of sanisation of forms he said now vast areas of the one one of Naples had been recently pulled down and new districts had been built. A large and splendid supply of water has been introduced since 1887, and when the drainage is completed, Naples will be one of the healthiest towns of Furope He spoke of the will be one of the healthiest towns of Furipe. He spoke of the poor classes of all our large towns, and said how they were the culture grounds of epidemics, and finished by saying that it is not enough to improve the sanitary conditions of a town, but that the principles of hygiene should be impressed on the minds

that the principles of hygene should be impressed on the minds and consciences of people, because there could be no public hygene where private hygene was not understood. Deputy-Surgoo General Bactock, C B, and Sir Vincent Barnington, delegates of the Metropolitan Asylums Board, read a joint paper on "The Hospital and Ambulance Organization of the Metropolitan Asylums Board for the Kemowal and Isolation of Infectious Director." diagrams, and models

Surgeon-General Bostock said that the present accommodation

for fever and diphtheria consists of aix hospitals :-

Name	Postion		Acreage.	No. of be	ds.	Population served.
Eastern .	Homerton	٠.		. 442		1,114,419
South-Eastern			11	. 46a	***	941,381
South Western			8	- 340		582,5QZ
Western .	Fulham		6			690,138
North-Western .	Hampstead		11	435	-	889.314
Northern	Wischmore Hil		36 .	480	***	_

The first five are in London. The Northern is for convaies-cents, and is four miles outside the northern boundary of the

district. The position of these hospitals is shown on the man The average length of the journey a patient has to be carried to reach the hospital nearest to his home is three and a half miles. Daring 1886-87 the number of beds in the eastern and western districts was found to be insufficient, and steps are now being taken to establish an additional hospital in the North-East of taken to establish an additional hospital in the North-East of London, and to increase the number of beds in the Western Hospital to 400 These additions will give a total number of beds for fever and diphtheria of 2959, or one bed for every 1423 inhabitants The total number of cases of fever and diph theria admitted into the managers' hospitals from 1870 to the end theria admitted uso the manageri hospitals from 1870 to the end of 1890 was \$5.50a. The accommodation for unall por it the Floating Hospital at Long Reach, fifteen unles below London the state and the Catalata, the Employmen being used for administrative purposes, and 80c in the convalencest liospital at 1150 below. The number of small port as the Catalata, the London the ships, group a total of 1150 below. The number of small port cases admitted and added 1026 cases other than small port, making a total of \$5.007 admissions. The river service is cachisvely used for small port cases, and consists of three whares on the Thanes and London cases, and consists of three whares on the Thanes and London for the emharkation of patients The wharves, as shown on the map, are the "West" at Fulham, the "North" at Poplar, and the "South" at Rotherhithe In each there is a floating pier in deep water, approached by a bridge, and a shed into which the ambulance carriage drives, with an examination room. As an example of the work, it may be stated that during the smallpox epidemic of 1884-85, 11,060 cases were removed from their homes to the Floating 11ospital, 175 doubtful cases were sent from the wharves to the land hospitals, 38 cases were detained in London on account of fog, and 35 persons, not having small nox at all, were vaccinated and taken home. The greates pox at all, were vaccinated and taken home. The greatest number of patients taken down to the Floating Hospital in one day was 104, by the Red Costs, in three trips A the close of the epidemic the Ambulance Committee were able to report the epidemic the Ambulanic Committee were able to roport the statisfaction they felt that so large a number of persons of many helplers from disease, had been carried in all weuthers, throughout all seasons of the year, and to a great extent during the hours of darkness, without disconfior or detriment to the pattents, and without mishap to any person ment to the pattents, and without mishap to any person. whatever.

Sir Vincent Barrington, after urging the importance of a sanitary point of view, presented statistical papers of fever and small-pox cases treated in Board hospitals. He commented upon the supposed prevalence of discase in 1887, and urged every publicity to be given to Board work, to get and urged every publicity to be given to board work, to get over the old prejudices of the working classes against send-ing patients to the isolated hospitals. He showed a chart demonstrating that the increased use by the public of the Board hospitals and the transport from 1879 to 1890, had been followed by steadily decreasing fever mortality in London Now over half the cases of scarlet fever in all London are probably treated in Board hospitals. He referred to the improved sanitation of dwellings and the decreasing severity of the type of the disease as factors in the decreased mortality observed duesase as factors in the decreased mortality observed. He presented small pox pedigrees in non epidema times, showing in one case that 19 persons, in another to persons, were indeted from a single case. Also that 20 cases of the 32 treed in the property of the presented the forms for recording the endence of the extense of vaccious of the presented the forms for recording the endence of the extense of vaccious of the improved systems. adopted after conferences with Board medical officers and the adopted after conferences with Board medical officers and the Local Government Board, and advocated other sanitary bodies adopting the same system, thus facilitating the compilation of statistics, invaluable for the advance of science, and therefore for the treatment and check of small-pox, and the consideration

for the treatment and check of small-pox, and the consideration of protection by vaccination of protection by vaccination.

The product of the protection of

Prof Stokvis and Dr. Dickson spoke on the subject.
Dr Pistor, of Berlin, read a paper entitled "Ueber die Desinfection," of which the following is an abstract. Dr Pistor
dealt with the general rules and methods to be observed in the
dunifection of infectious diseases. Such rules should be short,
cleai, and capable of being understood by everyone Incineration and boiling for half an hour are, of course, very effectual disinfectants, but they are not always applicable A I to 2 per cent solution of caustie soda is a very useful disinfectant. Other cent solution of caustie soda is a very useful disunfectant. Other methods are steaming, mechanical cleaning (such as rubbing, brushing, &c.), carbolic acid solution (2 to 5 per cent.), limewester containing about 20 per cent of caustic lime, and a 1 to 2 per cent solution of calcimed carbonate of soda. These methods and solutions are effective against all the poisons of infectious diseases. The head of the house or institution ought to be responsible for the disinfection under the direction of the doctor. and a record ought to be preserved of the mode of disinfection used

Sir William Moore, K. C. I. E., Q. H. P., read a paper on "The sir William Moore, K. C. I. F., Q. H. P., read a paper on "The Prevention of Feer in India." Prevention of Feer in India. "India of the India of the India of India o

remarks

Dr F M Sandwith, of Cairo, read a paper on "Cholera

in Egypt"
Dr Stekoulis, of Constantinople, and Dr Simpson, of Calcutta, took part in the discussion

Dr Curgenven, of Teddington, read a paper on "The Disinfection of Scarlet Fever and other Infective Disorders by

infaction of Scarlet Fever and other Infective Justices up Anti-epite Innucion of Sagowy, spoke to Dr. W. Gemmell, of Glasgow, spoke to Phaness & Abraham, of Lowlon, read a paper entitled by Phaness & Abraham, of Lowlon, to Sagowa May of Joronto, and Sagreon Major Pinnele spoke on this sulner. It P. J. P. Williams Tieenan, of Andover, read a paper and the distribution of the Sagowa May of Sagowa May of Sagowa May of Sagowa Sa importance, the causation of phthisis is a good example of it Foul art is a cause of tuberculous in three ways. driedly, by supplying the bacillus to the lings, and through the saliva to the intestinal canal, indiredly, by causing tuberculous in cattle, and by so rednang the human body's vitality as to render it a suitable indire. The bacteriologist leads us to expect that fresh art will be howtite to the virus, the demographis shows that the death-rate from philium increases from islands, coast dis-tricts, agricultural districts, small towns, to large towns; also trets, agreatural distincts, small towns, to large fowns a slow occupations, according to their exposure to the open air, from fainers and fishermer up to drapers and printers (see IV international and their exposure to the open air, from fainers as to be thinted towards of their through the alone, fully preventable, must be enormous. The 'buble Health and Excotose Acts provide for proper ventilation of bankings. Any standard that public opinion, lay and medical, space in common lodging houses, persically nothing if done, and the air of buildings is often "dangerous and injurious to health" An inspector should frequently "ample" the air of buildings, and the air of buildings is often "dangerous and injurious to health" provided on the control of the standard of the size of th the architect; the limit to be when the air inside a building contains twice as much carbonic acid gas as the air outside at the same time. This would usually correspond outside at the same time. This would usually correspond to De Chaumont's "Rather close, organic matter becoming perceptible." Students of preventive medicine should demand this reform from the administrators of the law. Polluted air is as recognizable, preventable, and harmful as unsound food or bad water, and should be treated on the same lines.

water, and anough or treated on the same lines.

Two other papers were taken as read, one by Dr. S. Lodge,
Jun., of Bradford, entitled "On the Occurrence of the Bronchopulmonary form of Anthrax amongst Rag-pickers in England,
and Suggestions for its Prevention," and one by Dr. H. Rident,

of Elbour sur-Seine, entitled "Des Troubles du Côté des agents de la Respiration chez les Fileurs, et de leur Conséquences.

After a speech by the President, complimenting the Secretaries on their work, and a vote of thanks to the President, the meetings of the Section terminated.

SOCIETIES AND ACADEMIES.

LONDON

Entomological Society, September 2—Mr Frederiek DuCane-Godman, F.R.S., President, in the chair—Mr G. F. Sout-Elliot exhibited a series of various species of Diptera collected on Kanuncialacae, Papaveraica, and Cristies H. Said that during the past summer he had studied about forty sad that during the past summer he had studied about forty species of plants belonging to the orders named, and that they had all been vasted by insects which were probably accessive were not confined to one species of even genus, but, in view of the unmodified character of the flower in the orders named, this was only to be especied. Mr Verrall observed that certain massets affected certain plants, but that the Grossiance were the confined property of the confined p on Danais chrysippies, a butterfly well known from its protective character and distasticful qualities to have a complete immunity from the usual Lepidopteral enemies. The Hemisaga lurked amongst the tops of tall flowering grasses, being consequently disguised by its protective resemblance to the same, and seized the Danass as it settled on the bloom. From close walching and observation, Mr. Distant could discover no other danger to in dishers than Sc. Duant for thomes or on these seguring of the process of the seguring of the life of than well-known and high protected butterfly—Mr. T. R. Billaps schubted four species of Dipters, whose believed to be respectively Osygora terminate, Pipterla believed to be respectively Osygora terminate, Pipterla sken at Osabot, Surrey, on July 11 bat II fee men taken at Osabot, Surrey, on July 11 bat II fee men taken at Osabot, Surrey, on July 12 bat II fee men toned that all of them were recorded in Mr Verall's list only as "reputed British" He also exhibited a specimen of Spytheterna beern Dig., taken at Plumetaed on July 29 last — Osabot, Surrey, Dig., taken at Plumetaed on July 29 last — Osabot, Surrey of Section 10 between conditions of the parts representing larva of Scoria desidate, rasted from over They were feeding larva of Scoria desidate, rasted from over They were feeding revolved to the section of the Section of the Section 10 between more last foot-plant for the species, but he did not find that the larva would est this or any other greas — The Rev Dr. Walker exhibited, and read notes on, a collection of Lepidopiern, Hymenoptern, Coloputern, Neuropiern, and Diptern, which he had recently made in Norous, and Diptern, which he had recently made in Norous, and

PARIS.

Academy of Sciences, September 7 -M Duchartre in the chair .- Remarks on the influence that the aberration of light may exercise on spectroscopic observations of solar prominences, by M. Fizeau Several observers have recently measured reby M. Freau Several observers have recoulty measured re-markably high velocities an salar prominences by the application of which the cruption consist he specied in the neighbourhood of which the cruption consist he specied in the stephbourhood of the eclipte with a velocity equal to that of the earth in its orbat, the prominence will suffer an apparent displacement of 20°445, in the same manner that a star as deplaced by 20°445 of the same manner that a star as deplaced by 20°445 light. Aberration should therefore be taken into account in determinging the positions and height saturated by the phenomena in question.—On the mumber of roots common to several simul-taterous equations, by M. Zimite Forder.—On the behaving of segataneous equations, by M. Emile Floard —On the blending of sepa-rate chromatic sensations perceived by each of the two eyes, by Ms. A. Chauveau If two colours are simultaneously and separ-ately received on the corresponding points of the two retinus and transmitted respectively to the nervous centres, do they blend Trainmented respectively to the nervois centres, up they never the content and give rise to the sensation of the resultant colour? This is the question investigated by the author. And he finds that there is a real blending of the colour perceptions resulting from the independent excitation of each of the two returns.—On the mituence of the product of the culture

of mephyloceque doré on the vaso-motor nervous system and on the formation of pus, by M. S. Arloing.—Observations of the Tubiosco Observation, by M. E. Cossent. Three observations for position were made on September 1 and one on September 2. —On the dutathous on latitude of the solar phenomena observed at the Royal Observatory of the Koman College during the first half of this year, by M. F. Tacchini Prominence have been half of this year, by M. F. Tacchni. Prominences have been most frequent in the southern solds be mulphere, as was also the most frequent in the southern solds be mulphere, as was also the cancer & 40-20. The spots and faculte have preserved their preponderance month of the equator, with maxima of frequency in lattitudes slightly lower than the prominences. All the spots of the sold of the spots of the sold of the spots of the sold of the spots of the spot by M P. Lesage

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

L'ungentessa die Espiestunoi Granti füera. H. H. Johnson (Philip)

Repety of the Marceloccul Dies. May to December 189 (Ege and Spouns, 189)

Repety of the Marceloccul Dies. May to December 189 (Ege and Spouns, 189)

Observations at Statutor of the Serond Conf. 189 (Ege and Egonator, 189)

Observations at Statutor of the Serond Conf. 189 (Ege and Egonator, 189)

The Association of the Serond Conf. 189 (Ege and Egonator, 189)

The Association of the Serond Conf. 189 (Ege and Egonator, 189)

The Association of the Serond Conf. 189 (Ege and Egonator, 189)

The Association of Serond Conf. 189 (Ege and Egonator, 189)

The Association of Serond Conf. 189 (Ege and Egonator, 189)

The Association of Serond Conf. 189 (Egonator, 189)

CONTENTS.		PAG
Animal Chlorophyll By Prof. E Ray Lankes	ter,	
FRS Streatfeild's Practical Organic Chemistry		46
	,	46
Telescopic Work	•	46
Our Book Shelf :		_
"Abhildungen zur Deutschen Flora H. Karsten's		46
Aitkin "Elementary Text book of Botany".		46
A New Mammal from Sumatra.—Prof. A. A.	w	
Hubrecht	٠.	46
An Oviparous Species of Peripatus.—Arthur De	ndj	
The Sun's Radiation of HeatW. Goff	•	46
Morley Memorial College Misa Emma C	on	
(Hon, Sec.)		. 46
American Association for the Advancement	۰	
Science Washington Meeting		. 46
	٠	**
	٠	. 47
Our Astronomical Column:-		
	٠	
Wolf's Periodie Comet		
Geology at the British Association		
Biology at the British Association		
The Congress of Hygiene		
Societies and Academics		48 . 48

THURSDAY, SEPTEMBER 24, 1891

PHYSICAL UNITS AND CONSTANTS

Illustrations of the C.G.S System of Units, with Tables of Physical Constants By Prof Everett, F.R.S (London: Macmillan and Co, 1891)

THIS may be taken to be the fourth edition of a work first published by the Physical Society in a somewhat different form Those who know Dr Everett need not be told that he has done everything that it is possible for an accurate, paintaking author to do, to bring each successive edition as near to perfection as possible. The value of the work to the physics investigator is exceedingly great, as everybody knows, but it is not so generally well known that it is an excellent class exercise book for students. There is much new matter in this edition, institution, and it is an excellent class exercise book for the physical properties of its possible chemens, magnetic properties of its propert

The labours of many men have given to the present generation this beautiful system of units, which has made physical calculation so easy, and which has pointed out in certain cases the directions in which new discoveries might be expected. And it only requires a short study of certain parts of this book to put any student in such possession of the system that he can use it with certainty and ease. Indeed, to become well acquainted with the scientific method of calculation has almost been made too easy for certain clever men of our acquaintance. It is far nobler to swim the Hellespont than to cross in a steamer At the present time many clever men are possessed by a mania for crossing the Atlantic in boats of eighteen feet keel It adds much more to one's credit to talk of all kinds of hybrid and home-made magnetic influences, than to use the simple idea of self-induction. In the same way it is unfair to say that certain practical engineers shirk the study of Dr Everett's book, it is much better to put it that these gentlemen have too much criginality to follow the easy path, and when in their practical applications of physical principles they adopt all sorts of ingenious units of their own manufacture to whose use there are limits in all sorts of ways, we can even feel sorrowful over their skilfulness, without attemptto thwart their ambition.

The mechanical engineer is accustomed to the use of a curious unscientific want of system in his calculations. His unit of force is the weight of a pound in London His velocity is in feet per second, perhaps, in the very same calculation as that in which his pressure is in pounds per square inch. It seems to be too late to change this No engineer can venture to educate his pupils in the use of the C.G.S system for mechanical engineering calculations Mrs. Ali Baba measured her gold by the quart, and a mechanical engineer thinks and designs and talks with other engineers in the usual shop units; and we may as well think of altering our decimal system to a duodecimal one, as to talk of an alteration in the mechanical engineer's methods of calculation. It is a very great pity, but the difficulties in the way of reform seem to be insurmountable. The story of these difficulties is too long for the present

notice. But in new applications of physics, in electrical engineering, for example, the use of the C G S. system is not only easy, it requires a large amount of ingenuity in any engineer to calculate in any other than in C.G.S. units, unless, indeed, he ignores all the experimental determinations already made for him and tabulated in the C G S system And yet such ingenuity has already been exercised, and laborious investigations have been carried out by some electrical engineers, with the result that certain parts of electrical engineering are getting to be even more unscientific in the units employed than any part of mechanical engineering. On behalf of the culprits we may say, however, that even Dr Everett's book their best guide-has not given them the precise information that it might have done. In the subject of heat, we can now ignore the steam-engine constructor. we can say to him, "Go on using your wretched pounds per square inch and your foot-pounds per minute, and we will go on using our dynes per square centimetre and our ergs per second because we are nearly independent of one another", but we can make no such speech to the electrical engineer. We physicists have to say to him that we rely upon him to make new discoveries, to state to us new problems, and if he gives us information in vague units of his own, we cannot tabulate it for general use, and if he does not state to us his problem in the usual language, we are unable to understand him, and we can be of no mutual use to each other But when he says to us that our language is cumbrous, that he has ideas to express for which we have no words, when he uses towards us, properly for once, that adjective "academic" which has been more misused than Shakespeare's word "occupy," the culprit and the judge change places.

We can blame him if he invents unsystematic units, but not until we have given him the language and units that are correct. And in some particulars the electric engineer has the right to blame us. For example, our definition of unit electric current is so stupd that a multiplier or divisor of \u03c4 or 4\u03c4 enters quite unnecessarily into all electro-magnetic calculation

Concerning electro-magnets and the magnetic circuit of a dynamo machine or a transformer, the practical engineer has a simple and quite modern way of considering problems, not yet recognized in such orthodox books as this of Dr. Everett Magneto-motive force and the magnetic resistance of a circuit are expressions which cannot be found in such a book, and it is not at all unusual for the orthodox physicist to treat the idea underlying the use of such expressions with profound contempt. The engineer and experimenter care less than nothing for "magnetic susceptibility" or for "intensity of magnetization," or for "free magnetism", these are, to him, mementos of the time of twelve years ago, when the inventor made bricks in Egypt, and the very cleverest mathematical electricians were only distinguished from other inventors by the greater magnitude of their blunders Dr Hopkinson and Mr Kapp and Mr. Bosanquet have given us simple ways of dealing with practical problems, and some of these are now known to every apprentice of an electric engineering factory, but we know of no mathematical treatise in which they are recognized. Is it too much to hope that Dr. Everett, in his next edition, will ignore the orthodox critics, and

mention ambere-hours, and ambere-turns, and Board of Trade units? It would perhaps be going too far to expect him to speak of the drop of potential per ampere in 100 yards of "a cable of nine-seventeens," for he does not aim at displacing the electricians' pocket-books; but it is to be remembered that of all engineers the electrical engineer is the one who is most inclined to orthodoxy. who most leans upon the mathematician and physicist. who is most likely to use such a book as this, and if Dr Everett can stretch a point in his favour, and devote, say, four pages to "electrical engineers' pocket-book" information, it will bind the electrical engineer to orthodoxy for ever Why, for example, should Dr Everett define the "impedance" of a circuit merely with reference to the circuit when conveying one particular kind of alternating current?

This book deserves much more than a short notice, and the time may perhaps come when one of our leaders will write a long critical article on the whole subject of units, pointing out the great differences in derivation of calorimetric units, for example, and the mere dynamical units employed in mechanics and electricity-an article which will teach the student that, although electric resistance has the same dimensions as a velocity, yet this is a very different thing from the statement that it is a velocity; that, in spite of Paris Congresses and Committees of the British Association, see ohm is a scientific name. and quadrant is not But, over and above all this, the writer of the article must not be, as the present reviewer is, a poor specialist, he must criticize this book from the point of view of the general physicist. This book contains the results of all the best experimental work of more than a century It is a book of mnemonics. A single line in the whole book recalls to us those magnificent memoirs of Dr Andrews which revolutionized our ideas on liquids and gases, and yet that single line is quite enough to the physicist It is dreadful and yet pleasing to think that all the work of a great man, or perhaps of a generation of great men, may be condensed into a single line of information in such a book as this Would Dr Andrews trouble himself very much over this fact if he were alive? or would he console himself with the thought that every physical fact discovered since 1869, and here recorded, was, to some extent, discovered through him, because he had made all physical workers his pupils? Would he need the consolation that Newton is not once mentioned, and that Sir William Thomson has less space devoted to him than the meanest of his pupils? Hundreds of years hence, the scientific world will be the better for the experimental work now going on, and it will have forgotten the name of almost every worker Our determination of something is only right to four significant figures, and so it will never be quoted because a man of next century will have measured it with accuracy to five significant figures. How many of us can be sure that a single line of such a book as this, published a century hence, will be devoted to the record of any of his experimental results? Is there or is there not a satisfaction in knowing that, one thousand years hence, the names of even Faraday and Maxwell and Thomson will be as little known as ours. The age deserves a Homer, and a memory of thousands of years; and one book of the epic ought to be

thousands of years; and one book of the epic ought to be a list of all the men mentioned by Dr Everett, saying NO. 1143, VOL. 44] what weapons each of them had brought for the common fight against the powers of darkness. Bút alas, the new Homer will probably not come into being for another three hundred years, and he will be a blind poet, and he will probably immortalize the wrong people.

JOHN PERRY.

OYSTERS

Oyslass and all about them Being a Complete History of the Titular Subject, exhaustive on all points of necessary and curious information from the Earliest Writers to those of the Present Time, with numerous Additions, Facts, and Notes. By John R. Philipots (London and Leicester Richardson and Co., 1891)

The Oyster a Popular Summary of a Scientific Study By Piof W K Brooks, of the Johns Hopkins University (Baltimore Johns Hopkins Press London Agents Messrs Wesley, 1891)

H ISTORIANS of the oyster revel in ambitious titles

"The Oyster Where, How, and When to Find,
Breed, Cook, and Eat it" suggested a somewhat extensive
field for the tiny octavo which Cluikshank illustrated,
but yet greater anticipations are raised by the title of Mr
Philipot's contribution to the subject.

Unfortunately, this promise is not borne out, not from lack of labour on the writer's part, but from the want of that critical knowledge which can alone make a compilation of this nature valuable Mr. Philpots has thrown together, with but little arrangement, into two volumes of 1300 pages, scraps from every conceivable source relating to the oyster, and this without any critical treatment whatever all are ovsters that come to his dredge Since at least as much erroneous information is current about the oyster as about any other well-known animal, and since it appears to exert nearly the same deleterious influence as the horse on the truthfulness of those who deal in it, it will be readily understood that the 1300 pages abound with errors and contradictory state ments, and form a most untrustworthy guide to the complicated subject of which they treat

The melancholy side of the situation is that, had the compiler, evidently an enthusiant for his subject, devoted the time and labour expended on the collection of paragraphs from untristworthy authorities, to qualifying himself for his task by obtaining a personal and practical acquaimtance with the oyster in all its relations of life, he might have produced a less bulky work, but one of permanent value, as it is, the only passages which we have been able to identify as indicating that Mr. Philipots has seen an oyster or an oyster-bed, are to be found in his account of ten sorts of oysters sent to him by a London dealer, among which, by the way, the real native does not occur (pp 33-36), and in chapter ux, containing a short account of the Poof Sharers.

To correct the errors of Mr Philpots's authorities, and to indicate his omissions, would be to criticute, not one book, but all the readily accessible matter which has been written on oysters for the last half-century; accessible matter only, for even as a compiler Mr, Philpots has not the requisite qualifications for his task, being seemingly dependent for his information about foreign oysters upon the translations and abstracts which have

appeared from time to time in the Report and Bulletin of the United States Fish Commission, and upon the Hand-books, &c., to the International Fisheries Exhibition. These, with Grenville Murray's "The Oyster, Where. How. When," &c. (1861 and 1863), Williams's "Silvershell; or the Adventures of an Oyster" (1856). and Evton's "History of the Oyster" (1858), are the chief part of his stock-in-trade, to which may be added newspaper articles, reviews, extracts from popular natural histories. &c Besides these "authorities," some fifty pages, largely taken from Gwyn Jeffreys's "Conchology." deal with Brachiopoda (1), Anomiadæ, Pectinidæ, and Ostreidæ; under the latter family there is an account of Ostrea edulis, but none of Ostrea (Gryphaea) angulata and virginica, although the book does not profess to be confined to the former species, and about 212 pages are occupied by reprints of Parliamentary papers of various

The only chapter in which we are at one with Mr Philpots is that in which an appeal is made to the Government to take the "oyster question" seriously in hand, though even here we cannot but regret the tone in which he speaks of the Board of Trade Unhappily, however, there is no denving the fact that the inspectors sent by the Board to report on oyster fisheries have often been unfit for their task, and have, sometimes at any rate, been freely fooled by interested parties, for want of a little practical acquaintance with their subject. This has been pointed out again and again, not only as regards oyster fisheries, but also iii connection with other fishery questions; but it cannot be pointed out too often A point to which Mr Philpots should have drawn public attention is that, if the proposition to move the London diamage outfall to Foulness take effect, the best of the few remaining grounds for breeding the almost extinct "native" (sensu stricto) will in all probability be ruined

A book of a different calibre is that of Prof Brooks It is avowedly merely an attempt to rouse the State of Maryland to take such measures with regard to the oysterfisheries as can alone prevent their ruin, measures such as some other States have already taken with marked success. It is hardly necessary to say of Prof Brooks that his little book is a clear and accurate summary of what is known about the American species, for few men can speak with more authority on the subject. We can only hope that the Legislature to which he appeals may be more far-sighted than our own. Had the restrictions which he advocates been laid on our English public beds fifty years ago, the rare "native" might be almost as cheap now as in those almost forgotten days when the market was not yet flooded with French and Dutch produce posing as the genuine article, and oyster grottos were a familiar feature of the streets

THE DESTRUCTION OF MOSOUITOES. Dragon-flies v Mosquitoes (New York D. Appleton

and Company, 1890) THE book before us consists of three prize essays written in response to a circular issued in 1880 to "The Working Entomologists of the Country," offering certain prizes for essays containing original investigations

NO. 1143, VOL. 44]

The prizes were offered by Mr. R H. Lamborn, whose position as Director of the Lake Superior and Mississippi Railway had caused him to spend a considerable time encamped in the swampy forests which surround the head of the great lake Here he came into contact with mosquitoes of the most irritating kind, and here he made the interesting observations on the "destruction by dragonflies which stimulated him to offer the above-mentioned prizes. The lines laid down in the circular as to the direction which the investigations should follow have reference chiefly to the destruction of these insect pests by dragon-fites. The competitors were also required to examine which species of Odonata are best adapted for the purpose, to investigate their habits, and the possible methods of breeding them in large numbers. But although this line of inquiry is suggested, the practical object of the investigation is to determine whether it is possible to diminish or extinguish the novious Diptera, and if so, by what means

The essay which gained the first prize is by Mrs C. B Aaron, who gives a careful account of the habits and life-history of both the Diptera in question, and of the Odonata, and then considers the advisability and the means of exterminating the former. The gravest charge which is adduced against these Diptera, apart from the irritation they cause, is that they act as carriers of such parisites as Filaria, and possibly of some species of I enia, whilst they undoubtedly serve to disseminate Bacteria associated with certain infectious diseases. In their favour it may, however, be said that they act as very efficient scavengers, especially during the larval period of their life-history, and it is a very open question whether the world would be much benefited by the total extinction of the two genera Culey and Musca Without attempting to decide this point, Mrs. Aaron proceeds to consider the possibility and the cost of attempting their extermination

The plan of pitting the dragon-fly against the gnat-a plan similar to that which Prof Riley has brought to such a successful termination by encouraging the destruction of the orange scale, Icerya purchasi, by means of a small beetle, the Vedalia cardinalis, imported from Australia-is dismissed in a few words, for reasons which are considered at greater length in the following essays; but several mechanical means are suggested, the most promising and cheapest of which, in the case of the mosquito, is to spray with crude petroleum all collections of stagnant water which cannot be easily drained. The oil forms a thin film on the surface of the water, and effectually clogs the aperture of the breathing tubes as soon as the larve come to the surface, as they must do, for air

The authors of the two remaining essays, Mr. Weeks and Mr. Beutenmuller, divide the second and third prizes The former commences his essay with a valuable table, giving details of the time of appearance, of the comparative voracity, and of the habitat of sixteen species of dragon-fly found in the neighbourhood of New York. From these, three are selected-Anax junius, and Eschna construta and heros - as the most likely to prove destroyers of mosquitoes When, however, the life-histories of the opposed insects are compared, it becomes at once on methods for destroying the mosquito and the house-fly, evident that we must not trust to the Odonata to rid us of

the biting Culicidae The breeding and artificial rearing of dragon-flies present almost mauperable difficulties, for, when the larval stage is attained, each individual would have to be isolated, because they are apt to devour each other when confined in a limited space. Irrespective of the question of breeding, an insect which produces but one brood a year, and lives but a few days in the image condition, has little chance of seriously affecting a race whose numerous annual generations succumb only to the severest weather. In its natural condition the dragon-fly does not correspond sufficiently closely with the mosquito, either in time or space, to give it any real chance of effecting the destruction of the latter, its breeding-places are also more restricted, as it requires a volume of water which is constant for some little time, whereas the mosquito, with its quicker metamorphosis, can make use of any temporary puddle

The conclusion to be drawn from all three essays is, that if a serious attempt is to be made to combat these most annoying insects, the means to be adopted with most chance of success he rather in the direction of draining wamps, raising fish, and encouraging waterfowl in the infessed ponds, and, where it would not be injurious, using crude oil, than in any efforts to increase the supply of dragon-files.

Mrs. Aaron and Mr Beutenmuller have appended to their essays useful last of papers on the subject of their work; and the latter has added a preliminary list of the Odonata in the State of New York, and a very useful catalogue of the "described transformations of the Odonata of the world." The book is illustrated with several plates, which deput stages in the life-history of the insects in question, and various mechanical devices for attracting mosquitoes, by means of lamps, to an oily grave, and for spraying with petroleum the water in which they breed

OUR BOOK SHELF

Materials for a Flora of the Malayan Pennsula No 3 By George King, M.D., F.R.S., &c Repnnted from the Journal of the Asiatic Society of Bengal, Vol. LX Part 2

Dis, Kino's third contribution towards a flora of the Malayan Peninsula contains the Malayande and comprises almost as large a proportion of new species as the two Malayande Peninsula contains the Malayande, and comprises almost as large a proportion of new species as the two manner trends, but the proposed of the pr

Zoological Wall Pictures. Three Diagrams, each 32 inches by 42 inches. (London: S.P.C.K.)

The Animals of the World, arranged according to their Geographical Distribution. Third Edition, Revised and Re-drawn. Size, 58 inches square. (London. Moffatt and Paige)

THE first named depart (1) fishes, as represented by the cod, eel, and herring; (2) chelonians, as exemplified by the common water tortoise and the Greek land tortoise, together with drawings of parts of the chelonian skeleton; (3) insect peats, in the persona of the Pine Bark and Colorado beelles, the larve of which are delineated The diagrams are both bold and accurate, and good of their class.

The second named embodies an attempt to represent the distribution of the animals selected in latitudinal series. The plan, although a good one, is manifestly insufficient, insamich as by its means no provision can the picture may be recommended. Its meaning is at once obvious, and a fact such as the occurrence of seals and whales at extreme latitudes, which at once arrests the attention, is sufficient in 1stell to arouse the spirit of "bound" of the article ""bound" might with advantage be substituted for the article ""The "which beads the tille

Croset's Voyage to Tasmania, New Zealand, the Ladrone Islands, and the Philippines, in the Years 1771-72 Translated by H Ling Roth Illustrated (London Truslove and Shirley, 1891)

IN 1769 a Fahitian was brought to Europe by Bougainville as "a human curiosity" Afterwards he was sent to the Mauritius, the Governor of which was instructed to forward him to his destination The task of restoring him to his native land was undertaken by Marion du Fresne, who was then a well-to-do resident in the Ile de France, and thus originated the expedition the story of which is recorded in the present volume. The party staited in two vessels, and Marion proposed, in the course of the voyage, to do much exploiing work—a kind of enterprise for which he seems to have been well fitted, as he had been a distinguished officer of the French navy Unhappily, some members of the expedition, including Marion himself, were massacred by the Maories The voyage, however, was continued, and in 1783 an account of it was published which had been compiled and edited by the Abbé Rochon, the well-known traveller, from the log of M Crozet, who, after Marion's death, commanded one of his two ships It is this account which Mr Ling Roth has translated The work will be read with interest by students of the history of geographical discovery, and a good many of M. Crozet's statements about savage life have considerable value from the point of view of the ethnographer and the anthropologist A preface, and a brief reference to the literature of New Zealand, are contributed by Mr J. R Boosé, Librarian of the Colonial Institute, and the volume contains, besides maps, very good illustrations of some works of Maori art

Levingstone and the Exploration of Central Africa. By H. H. Johnston, C.B., F.R.G.S., &c. (London: G. Philip and Son, 1891)

THIS volume ranks with the best of the series to which it belongs.—"The World's Great Laphorers and Explorations." Mr Johnston realizes fully the splendour of Livingstone's achievements, and has succeeded admirably in bringing out their significance in the history of African exploration. He begins with two excellent general chapters dealing with the "natural history" and the "human history" of Central Africa, and afterwards be gives vivid accounts of all the various regions traversed by his hero. Thus the reader is enabled to form his own opinion as to the value

of Lumgatone's services. The strictly bographical part of the work is equally well done. All the world agrees that Livingstone was one of the noblest men who have ever devoted themselves to travel. This is felt strongly by Mr. Johnston, and he has been able to express his feeling effectively without extravagence and without any attempt effectively without extravagence and without any attempt readers, but may be studied with pleasure and profit by readers, but may be studied with pleasure and profit for readers, but may be. There are many good illustrations from photographs or drawings by the author, and seven maps by Mr E. G. Ravenstein

LETTERS TO THE EDITOR.

{The Editor age: not hold himself responsible for opinions expressed by his correspondents. Nisther can he undertake to return, or to correspond with the writers of, resident measurerspits intended for this or any other part of NAIURE. No notice is taken of anonymasi communications!

The National Home-Reading Union

WHEN one remembers the difficulties with which one's own inst efforts to study Nature were beset, it eems a pity that any youthful student should be ignorant of the existence of an organization which can do much towards making his path smooth

"The National Home Reading Union endeavours to guide those who eannot obtain awail instruction into the safest and most attractive roads. Luts of books are drawn up, difficulties and discrepancies in systematic reading are, as far a nosable, and the second of the safest and the second of the safest and th

books with which to commence their required.

I trust that this good work will commend itself to you as worthy of notice

ALEX, HILL

Downing Lodge, September 17.

Notoryctes typhiops

ALLOW me to protest against the misnomer "Mansqual Mole" applied to Dr. Strilling's marrelloss mammal by Mr. Scalete, both in the Timer and in NATURE "Mole-like Marsupath" is may be but the other phrase his quote a different control of the contro

"W = Mg"

I wish that Prof Greenhill would kindly explain to a bewildered reader of your paper the nature of his quarrel with "W = Mg_* " and with the writers of "theoretical" treatises who use this equation

To those trained to regard quantity of matter as measured by its inertia, and who regard the "mass" of a body as the quantity of matter, so measured, which it contains, the equation

tity of matter, so measured, which it contains, the equation $M = M_0$ has a perity dear measure of the certain body. That is mast M_1 , this being the measure of the certain body. The mast M_2 mast M_1 matter of the contract of the containing M_2 matter of the contract to have an acceleration g. We argue, from Restoris experimental laws, that there is a force acting dh it, and we measure that force by a number which is the product of the two numbers, M (the measure of the auss of the body), and g (the measure of the acceleration observed).

NO. 1143, VOL. 44]

If we observe a right suring attached to the body in question and we observe a right suring attached to the body in question for the observed acceleration, we say that M_C measures the tension of of the string, or write "T = M_C." If the acceleration be due to the presence of the earth only, we say that the earth due to the presence of the earth only, we say that the earth managed by M_C. Thus force we call the "weight of the body", and the equation W = M_C gives us the measured by M_C. Thus force we call the "weight of the body" as deduced from the observation of rate of change of momentum

If I felt sure that Prof Greenhill considers M to be still merely a convenient abbreviation for W, I would say more on this matter, but I am in doubt as to what are the views of which he is so strong an opponent I see that the wishes to abolyth "e" from works on hydro-

I see that he washes to abolsh "c" from works on hydrostates. Why? I do not see how we can convenently indicate the dependence [caters, farthar] of hydrostatic pressure on the strength of the earth's gravitational field of force at any given place otherwise than by the introduction of g. But, as I have already implied, I am as yet in the dark as to the pieces, nature of the quarrel between Prof. Greenfull and the theorists Devonort. August 17. W. LARDEN.

[Ws look to America for clear, unprejudiced ideas on the definitions of elementary dynamics, and Mr. Frederick State's letter from California is a valuable contribution, to which I hope Mr. Larden has directed his attention

The quoistions from certain elementary treatises which form Mr. Larden's letter are the statements it was my chief object to dispute, according to this school of writers, the Standard Pounder Weight is not the lump of platnum preserved at the Exchence, but rather it is the pressure on the bottom of the box in which its kept.

If N. Appl.

18 N.

Let Mr Larden consult the recent Report of the Committee on Electrical Standards, to see how carefully the units must be defined to satisfy practical commercial requirements —A G G]

Willin I was young, I never had the presumption to understand the use of "v" in questions connecting mass and weight, and I fear my boy takes after me II. told me the other day that he understood how a falling

He told me the other day that he understood how a falling body could have its velocity increased per second with n velocity of g, or 32 feet per second, and that he knew that m = stuff in a body, and u v = its weight, but he could not see what the "blooming g" (I think that is what he called it) had to do with the matter.

I replied that no doubt, if we could only understand it, it had a beneficent use in the economy of nature TOMMY ATKINS, Senior

Sleep Movements in Plants.

I stan the other day in a local paper that "Mr. Scennin, the naturalist of Kellert's Arctic Expedition," states that plaint undisposlesp movements it regular intervals (presumably once in 24 hones) dismign the long period when the san never sets a plant does not undergo periodic variations of the kind if it has been been subjected to the regular succession of thyl and darkness. Other instances are the daily periodicity of the strength reads of the strength o

An Oviparous Species of Perspatus

Ms. Destroys observation of the extrusion of incompletely developed eggs in Perspetts is not, as he appears to think, entirely new Capitan Histon was the first to observe it, in Properties in most positive from the support of the same species in my monograph of the geins. No one knows whether species in my monograph of the geins. No one knows whether the properties of the same properties of the same species in my more properties of the same should be a supported to think that the properties of the same should be a supported to think that the properties of the same should be a supported to the same should be a s inclined to think that the process, which has only been observed in animals in captivity, is an abnormal one, and is caused by the alteration in the conditions of the animal's life. We know that the New Zealand species does bring forth fully developed

I hope that Mr Dendy will carry out his intention of fully investigating the development of the Australian species

Trinity College, Cambridge, September 18

A Rare Phenomenon

On a visit to Dunecht, I was just leaving the Observatory about 11 18 C M T on the 10th inst, when I saw a sharply-defined straight streaks of light arching the sky from east to west It was about 1' in width, and of uniform brightness from side to aide, but more intense towards the westen horizon, where it disappeared behind the trees at an altitude of some 4 Eastward it extended across the constellation of Andromeda near the girdle, quite beyond the convergence point of auroral rays, or fully 120° from the western horizoo This much I saw,

but cannot say if the streak passed north or south of the Great

Nebula. Endeavouring to lay down its course, I perceived that it was rapidly fading, and at the same time drifting southwards at a rate of, perhaps, 1° in five minutes. At 11h 21 om G.M.T. + 23' (1840 o) In the meanime the castern portion not inotes away. Although there was a bright auror: an the north-north-west, I did not think that the streak was auroral in character, but rather that it had been caused by the passage of a large meteonie. Next day, however, I stumbled on an account of a annular appearance seen, together with an aurora, by the Rev Edmund Barrel, at Sutton at-Hone, in Kent, on March 30, 1717 (O S) In the Philosophical Transactions, vol. xx, , after

1717 (O S) In the Philosophical Transactions, vol. xx., after determing an ordinary autors, the account mas,—
By Berr Eleven a Clock, there was (besides the Northern By Byth Eleven a Clock), there was (besides the Northern By Byth Eleven a Clock), the proposed that and a County and County and County and County and County and covering Arturns, proceeded and, pear Herseld and so went over Cor Lowers, and thence to Counting (Program, and so went over Cor Lowers, and thence to Counting (Program, for Siruss had already set) and ceded a butle beyond that Start I shone every bright at first, but faced away in about Eight or Nine Minusles. If it had Noturn (which I am not sure of) it was Southward 1 as aurel for the next Fit of Prightness of the Autora, and in about Seven Minutes, the Eastern Part of the Streak, viz from the Serpent's Head to near Berimies Hair, became visible again the dim, and was quite effaced in Four or Five Minutes more And I did not yet perceive any Change of

ber 14, dated September 12, says - There appeared here last night, between nine and ten, a very bright, luminous arch, reaching from south west to north east. It extended directly over the zenith from horizon to horizon, and formed a very interesting speciacle while it lasted, which was only about half an hour I ts seemed to be of electric origin from its wavy motion, and was slightly tinged pink at the eastern point just above the horizon.

Assuming the correctness of the dates on which the arch was observed—and of the Dunecht date I am quite certain—it seems that this rare phenomenon was visible on two successive mights RALPH Royal Observatory, Edinburgh, September 21. RALPH COPELAND.

NO. 1143, VOL. 44

Last Friday, the 18th, my attention was called at 9 p.m. to a most remarkable appearance in the sky. It consisted of a luminous band stretching from the eastern horizon to the west, and passing a little to the south of the zenth 1 t was first een and passing a little to the south of the routh. It was first seen there at 8 20, and began as a lumnous ray coming up from the west, but when I first saw it, it had extended as described from sets to east. It was like a straight and of a large coment with as head below the hormon, or the treek of the beam from a powerful electric search light. It causatre med lay a little to the passed through Corona Storeals. The night was a brilliant satisfact one, and small stars could be seen through the luminous hand! It was seen in the Co Kidare, 50 miles from here, and here it passed through the zenth also, which would show that it was a largest altitude. It gradually facted away, and was gone at 9 20. It would be of nitnests to know if it was longer at 17 th would be of nitnests to know if it was observed in other parts of the country

Daramona, Streete, Co. Westmeath, September 16.

SOME NOTES ON THE FRANKFORT INTERNATIONAL ELECTRICAL I XHIBITION

ON arriving in Frankfort one finds oneself in a lofty, palatial railway station, compared with which King's Cross looks mean and Victoria Station is a shanty This new terminus at Frankfort is not, as with us, an hotel with trains whistling and shunting in the back premises, it is essentially a railway station, standing And the practical Englishman is as much impressed by the completeness of its internal arrangements as by the anti-Ruskin lesson it teaches, that architectural skill when fit) applied to a railway station can produce as noble an edifice as when bestowed on a temple

Leaving the railway station all is changed. We are on the outskirts of the town, amid unfinished houses, heaps of bricks, vacant plots strewn with rubbish, and the tion is close at hand, composed at first sight mainly of wooden hoardings, temporary structures, "restaurations," and bier hallen it is the Chalk Farm fair again of our early youth, or Chicago in 1873, a month after the great Presenting at the entrance a letter bearing the magic pass-words "Prufungs Commission der Internationalen Electrotechnischen Ausstellung," we are ushered past the barrier with bows, and find ourselves surrounded on all sides by shows—Siemens and Halske's Miniature Theatre. admission 2½d, Electrical Ballet, admission 12, 2s, and 3s, Diving Pavilion, seats 5d, standing room 2½d., Electrical Race Course, 2½d, Siemens and Halske's Dancing Flames, 2½d, and so on, all over the Exhibition grounds. Have we come all these miles, at an invitation conveyed to us through the English Foreign Office, merely to visit a

collection of what are literally two penny-halfpenny shows.

We try one of then, the Miniature Theatre, passing in by the stage door, through the courtesy of Messrs Stemens' representative, and thus avoiding the crowd of people that flocks in at every one of the many afternoon and evening performances. In view of the audience are 48 handles, which work a large puppet show, but a puppet 40 handies, which work a large pupper show, not a pupper show without puppets, without music, without acting, without even a joke. Turning any one of 36 of these handles towards the left turns on a group of luttle white or red or blue incandescent lamps placed at the sides, at the top, and at the bottom of the little stage, but hidden by the scenery from the audience. Turning any one of by the scales within the autoience. Furning any one these handles to the right also turns on the respective set of lamps, but now their brightness can be gradually diminished by revolving one of the remaining 12 handles, which gradually introduces resistance into the particular cucuit. For example, either the red, or the white, or the

blue lamps behind any side wing, top drop, or set piece, can be separately turned on, or all can be turned on and the brightness of the lamps of any one colour varied independently of the brightness of the remainder

A bell unkles, and the curian rises, showing a pretty set scene of a Swiss village with mountains in the background. It is late in the afternoon. The attendant slowly revolves one of the resistance handles—the daylight wanes, the shadows grow long, the sun sets, and the snowy peaks of the mountains are ruddy with the Alpine glow. The effect is so lifetile and so beautiful that a-pon laceous easo of admiration is forced from the audience.

Then the stage grows gradually dark, lights are seen at the cottage windows, but the night is stormy, for the attendant now works the handles rapully, as does the organist the stops when performing one of last's fugues lightning plays on the hills, now a blinding flash lights up the road, the houses, and the waterfall, but the flashes grow less wird, and one sees, or thinks one sees, the most rise, the audience feet the quiet of the bright moonlight night, then the dawn, and finally the sunshine bathes the scene with light!

Since the opening of the Exhibition many theatrical managers, we were told, had ordered complete sets of this electric apparatus, and no wonder, for on it can be already and the managers of colors.

ints electric apparatis, and no wonder, for on it can be applied a symptomy in the music of colour and flainkets "dateing fames," the soles at this show being also well filled with a two-pench-alignent paying audience First, Koenig's manometric flames were described and shown in action, then Dr. Frochech's method of working them from a distance, the elastic membrane of the little gas-bag being punched in and out, not directly by the an puffs, but by the motion of the ferrotyped iron disc of a telephone, the current through which was varied by speaking to a microphone. Next were shown some extending the state of the state

We presume that the considerable number of people who, having paid for their entrance to the Electrical Exhibition, are willing to form group after group and pay nextra fivepence at the many performances that are given daily of these two shows by Messrs Siemens and Halske, are not wholly ignorant of what they are paying to see Probably, therefore, the continued attraction peoples soully another proof of the fast that science, and a love of science, have permeated to a much lower stratum of the nation in Germany than in England

Numerous must be the Germans not much above the level of the sightness at a village faur who have already instend to the explanation of Dr. Frockich's method for exhibiting these alternate current phenomena, and yet exhibiting these alternate current phenomena, and yet the visitors. For it was only some three months ago, when Prof. Ferry showed his new steam-engine indicator to the Physical Society of London, that the President suggested how he thought it possible that that instrument might be converted into an oscillating telescript on a screen the current curve of an alternate current dynamo. But nobody at the meeting was apparently aware that Dr. Frockich had been employing a telephone with a mirror on its disc for this very object—such as the resistance to the spread of rideas introduced

by difference of language
The apparatus employed by Dr. Froelich is as follows.

—A large telephone iron disc has a small piece of looking-giass stuck on tecentrically, and at the back is a horse-shoe permanent magnet, the soft iron pole-pieces of which are wound with a coll carrying the current pro-

duced by an alternate current dynamo. The iron due is therefore pulled more or less by the magnet, depending on the strength and direction of the current passing round its poles. A beam of light from an electric lamp is refecced from this murror on to a screen, and as the alterphical pole of the strength of the strength of the strength of the strength of the current produced by the machine. At least, this will be the case of the natural period of what along the strength of the current produced by the machine. At least, this will be the case of the natural period of what along of the telephone plate to the current produced the period of what along the the period compared with the period time of the current—a condition we presume Dr. Froelich has attended to

and attended to motion of the spot of light at right and gold to the found rine. It Profetch does not cause the telephone to be moved backwards and forwards with no scillatory motion, by the rotation of the dynamo amature, as suggested at the Physical Society of London, but before the beam of light reaches the screen, he causes it to suffer a second reflection from one of a series of small plane vertual mirrors, arranged around the worm-gearing, the quick rotation of the dynamo causes a somewhat slow rotation of this cylinder, but quick enough to produce an apparently continuous houtonid beam of light along the streen if there he no current flowing—that is, if the mirror on the telephone plate be at rest thence, the combination of the vertual and horizontal motions of the beam produces a curve which shows the five berrolls.

five periods

The effect of adding self-induction or mutual induction or capacity to the circuit is instantly seen by the change on the whape of the current-curve on the screen, and the change of phase is also evident from the shifting of the whole series of waves sideways. The comparison between the current waves in the primary and secondary circuits of a transformer is also very pertityl justistated.

Ihis lecture concluded with an exhibition of an apprixus that has been constructed for Dr Froelich for the examination of compound sounds. On a sharp tuning at a uniform velocity, are eight little alternate current dynamos, and by pressing down a piano key, which closes the circuit of the particular dynamo, a current is sent round the soft iron pole-pieces of the horse-shop permanent magnet at the back of a elephone discount of the particular discou

An Englishman finds it somewhat exasperating, if he desires to see the whole Exhibition, to have to be constantly taking out his purse to make small payments for entiance here and entrance their entiance here and entrance their entiance the state of the freedy for the shows go to the Exhibition authorities, they will be saved from the financial Janus that attended the Edinburgh Exhibition of last year, for that Exhibition had to be finally declared bankrupt, even after all the money guaranteed by the promoters had been called a pilenton of electricity to industry and art the mere basas element, that has been so prominent in feature at some of the Fishitions held at Earl's Court, sprenticully non existent at the Frankfort International Electrical Exhibition. International, however, the Exhibition is but in name,

International, however, the Exhibition is but in name, the comparatively small exhibits of one or two Engish and American firms only serving as a reminder of the magnificent collections of electrical machinery and apparatus England and America could have contributed. As a display, however, of the part Germany is playing in the development of electrical industry, the Frankfort Exhibition is most interesting.

Two separate buildings are devoted respectively to electrical railway signalling and telegraphic and telephonic exhibits. The Government have contributed an interesting collection of historical telegraphic apparatus, from which it may be seen that the signalling ratus, from which it may be seen that the signalling ratus, from which it may be seen that the signalling work of the contribution of the contr

There is one detail, however, in connection with the German Post Office, that force steel on the admiration of the foreigner. If you desure to send money, you hand in the sum at the post-office, with a postcard costing 24d, which you address to your correspondent with details of the sum sent, and receive a receipt in exchange. But you need write no letter, send no postal order nor receipt, or correlation of the control of

The display of telephonic apparatio at the Exhibition is large and complete, but owing to the activity of the commercial traveller of the day in keeping English and an administration of the commercial that is being engineer acquainted with processing that is being phone engineer as new A new telephone exchange witch-board, constituted by Messrs. Mix and Genest, contains, however, a point of novelty, and a switch-board contains, however, a point of novelty, and a switch-board Telephone Exchanges and the Berlin Telephone Exchanges.

The general arrangement of an exchange switch-board is as follows. "The writer from all the subscribers are brought to all the clerks at the exchange, so that it is possible for any clerk to onnect any subscriber with any other. In the clerk the context of the clerk of the cler

Suppose, now, that clerk A recoives a request from subscriber 85 to be put in communication with subscriber 500, the first thing to find out is whether the line of subscriber 500 is free, or whether it has been already connected with some other subscriber by one of the other nected with some other subscriber by one of the other subscriber by the subscriber by the subscriber by the subscriber by the subscriber by one of what is sword as a "steamy subscriber by the subscriber b

The ends of the plugs which the clerk presses into the NO. 1143, VOL. 44 various holes, or "spring jacks" as they are technically called, for the purpose of connecting one subscriber with another, are made electrically in two parts, the tip of the holy being being insulated from the remainder by a piece of plug being insulated from the remainder by a piece of the sacch pur of plugs, in such a way that on inserting the to each pur of plugs, in such a way that on inserting the post of the second of a pair of plugs into a spring jack, an instantaneous current passes, deflecting the needle of a galvanoscope of the second inche being recommended the second plug into spring jack 560, and as the top of this second plug into spring jack 560, and as the top of this second plug enters the spring jack steep will be a ninstantaneous swing of the cloth of the second plug into spring jack 560, and as the top of this second plug enters the spring jack steep will be a ninstantaneous swing of the cloth spring jack 560, and as the top of this second plug enters the spring jack steep will be spring jack s

Long-distance telephony is admirably illustrated by the opera at Munich being heard every evening with marvellous clearness at the Frankfort Exhibition, some 200 miles away

The most striking feature of the Likhbition—indeed, the exhibit that has brought many a foreigner hundreds of miles to Frankfort—is the electrical transmission of ower from Laufen, over a distance of 100 miles. No measurements have yet been made by the jury of the exact amount of power that is received, or of the efficiency of the transmission, but as over 1000 sixteen-candle lamps are daily fed by the current, as well as an electro-motor pumping up water to form a large artificial waterfall; the scrulp power received must be something like it out or 110 actual power received must be something like it out or 110 actual power received must be something like it out or 110 actual power received must be something like it out or 110 actual power received must be something like it out or 110 actual power received must be something like it out or 110 actual power received must be something like it out or 110 actual power received must be something like it out or 110 actual power received must be something like it out or 110 actual power received must be something like it out or 110 actual power received must be something like it out or 110 actual power received must be something like it out or 110 actual power received must be something like it out or 110 actual power received must be something like it out or 110 actual power received must be something like it out or 110 actual power received must be something like it out of 110 actual power received must be something like it out of 110 actual power received must be something like it out of 110 actual power received must be something like it out of 110 actual power received must be something like it out of 110 actual power received must be something like it out of 110 actual power received must be something like it out of 110 actual power received must be something like it out of 110 actual power received must be something like it out of 110 actual power received must be something like it out of 110 actual power received must be something like it out of 110 actual pow

The plans had to be rapidly formed, for it was not until May 1 that it was definitely decided to carry out the experiment. The transformers have, on the one hand, been duplicated, from an anxious dread on the part of each firm of contractors that the other would not have finished of the proper size are yet only partly ready, and many are defective from too hurned baking. Permission to carry the wires had to be obtained from the four Covernments of Baden, Hesse, Wurtenburg, and Prussa, and every sep of construction had to be taken under the depressing influence of caviling criticism. But in spite of all these means of three overhead bare copper wires, each only o 158 inch in thickness, supported on poles such as are used for ordnary telegraph lines, it is possible to deliver some 110 horse-power at a distance of nearly 110 miles from the water stream where the power is produced; and further, that this may be done without excessive loss in the control of the control of

The result is of international importance. The methods that have been employed (and which will be fully described) will probably not be copied in detail on a future occasion; there are doubtless faults which the cautious engineer can criticise; but the broad fact still international control of the cautious engineer can criticise; but the broad fact still in conception as it has been successful in its realization, the Allgemene Electricitats Gesellschaft of Berlin, in conjunction with the Oerlikon Works of Zuroch, have made the thoughtful realize that towns like Milan, which we within 36, 40, or 30 miles of vast water-power, may say full that the control of vast water-power, may say if it had been shown that such towns atood on an inexhaustible field of smokelses, dutaless coal.

(To be continued.)

SOME POINTS IN THE PHYSICS OF GOLF

I N my former paper (Nature, Aug. 28, 1899) the main conclusions were based to a great extent upon the results of mere eye observations, otien of a very uncertain and puzzing kind. The data so obtained were unfortunately not those required for a direct investigation, so that my processes were necessarily of a tentative character. During and since the last College session I have been endeavouring to obtain some of the more important data in a direct manner. I am thus in a somewhat more character position than before but, as will soom appear, the control of the control of the soft of the fight of a golf-ball.

One point, however, which is both curious and important, has been clearly made out -hammering has no effect (or, to speak more correctly, only an inconsiderable effect) on the coefficient of restitution of a volf-ball. This conclusion, which may have to be modified if the striking surface be not plane, had for some time appeared to me as almost certainly correct, and I have recently verified it by means of the Impact apparatus with which I have been working for some years I procured from St Andrew, a number of balls of the same material and make, half of them only being hammered, the others plain. The results obtained from a hammered, and from an unhammered, ball did not differ much more from one another than did those of a number of successive impacts on one and the same ball In the Badminton Library volume on Golf, Mr Hutchin-son quotes a statement of mine which appears at first sight diametrically opposed to this experimental result, and thus puts me in the position de mer ce qui est el desployee ce que n'est pas. But he has omitted to men-tion that my statement was expressly based on the alle gation that a hammered ball had been definitely found to acquire greater speed than an unhammered one seemed to me even at the time very doubtful, and I now know that it is incorrect] Thus it is clear that the undoubtedly beneficial effects of hammering must be explained in some totally different way There is another, and even more direct, mode of arriving at the same con-clusion. To this I proceed, but unfortunately the new point of view introduces difficulties in comparison with which all that has littherto been attempted is mere child's In short, it will be seen that the problem of a golf-

by its survey is were excessed in the property of the solution of the speed. The solution I then gave was only approximate, and imitted by the assumption that the cosine of the inclination of the path to the horizon might be treated as unity throughout. The illustrations and extensions given were founded on the same basis as was the solution of the sumpler problem. Shortly after it was more exact determiny the help of Bashforth's tables, a more exact determined that the solution of the sumpler problem. Shortly after it was more exact determined the solution of the sumpler problem. Shortly after it was more exact determined the solution of the solution of the sumpler problem. Shortly after it was more exact determined the solution of the sol

As a contrast, take $\lambda = 1$ I, so that $u_0 = 100$ feetseconds. To obtain the observed range we must take NO. 1143, VOL. 44 $\phi = 23^{\circ} 25$, which is considerably too great. The other numbers then become

The first numbers are in remarkable accordance with the numerical details of really good drives which lo bataned from Mr. Hodge, and, were there no other crucial test to be satisfied, the problem might have been regarded as solved to at least a first approximation. But I felt very carried to a least a first approximation. But I felt very carried as the state of the state of the state of the state of the carried was a solved to at least a first approximation. But I felt very carried was a state of the state

The initial speed in the flist estimate seems to be excessive, as will appear from the experiments to be described below. This, of course, is one mode of explaints of the state of the sta

experiments with the view of care determination further to be the help of a ballistic pendlum, but the results of these cannot be regarded as very satisfactory. My pendlum was a species of stiff but light lattice-girder constructed of thin, broadsh, laths. This hung from hard cold kine-legies set well apair, and supported a mass of the clay was plastered into an early cubical wounder. The clay was plastered into an early cubical wounder men to the control of the floor. The ball was divine min to from a distance of about six feet, and as near is possible to the centre of about six feet, and as near is a possible to the centre of about six feet, and as near is a possible to the centre of about six feet, and as near is a possible to the centre of about six feet, and as near is a possible to the centre of about six feet, and as near is a possible to the centre of about six feet, and as near is a possible to the centre of about six feet, and as near is a possible to the centre of about six feet, and as near is a possible to the centre of about six feet, and as near is a possible to the centre of about six feet, and as the consequences of an ill-directed drive. In fact, several rather unpleasant accidents occurred during the trait, especially in the carrier stages, when during the trait, especially in the carrier stages, when the later work. Although the clay was so siff as to

preserve its form under gravity, the ball (when it struck the face near the centre) always penetrated to a depth of more than one disameter, and spisabed fragments of the clay to a considerable disance. These were usually replaced, and the surface levelled for a fresh experiment, as soon as the ball was dug out. The speed of 900 feet per second, thus measured, may be taken as an inferior limit to the injural speed in a really fine drive.

It thus appears that the resources of mere particle dynamics are quite insufficient for the adequate solution of the problem of long driving; though, of course, they fully meet all questions connected with mere approach shots, and that the rotation of the ball must play at least as essential a part in the grandest feature of the game, as it has long been known to do in those most distressing it has long been known to do in those most distressing the same of the same of

powers
In order that the path of the ball may be (for a short time) approximately straight, still more if it is to be concave upwards, the downward acceleration due to grawity material time. The provided in the concavity of the

I have not hitherto succeeded in my attempts to apply even approximate calculation to this altered set of conditions—but it is easy to see, without calculation, that the longer the path of the ball retains nearly its initial inclination to the borroin (even if, in achieving this, it should have to expend part of its energy of translation along with that of rotation, and thus diminish the rangely the longer will be the time of its flight during the carry.

And, as a practical deduction from these principles, it would appear that to secure the longest possible carry, the ball should be struck so as to take on considerable spin—so that the ideal driver should be in truth a Bulger, but with the impostant variation that its bulge should be of considerable curvature and in a prominent part of the face (above the horri) must of course be less than the radius of the ball. How much less can be found only by trial. And, in addressing the ball, the player must stand directly opposite to it. Such clubs, however, could be profitably used only by really good players—men who can his with with gata for if the club they please, tway anythow, and (with ordinary club) manage occasionally to make a really "tall" drive, will probably smash the proposed form of club on the very first appearance of toping. As to those who propel the ball by "skitting" rather than driving, any change must be an improvement, so that they should welcome the proposed novely. The applied with a rough file, and the new system rises at once out of the old.

There is one other point on which opinion seems to be so unsettled that an allusion may be made to it here—the effects of weather on the carry of a ball. Of course, other circumstances being the same, the only direct effect

is on the coefficient of resistance. If this be taken as proportional (roughly) to the density of the lar, it may vary, in this climate, to somewhere about ten per cent. of its average amount, by increase or by diminution. It has its greatest value, and the drive is accordingly shortest, on a dry cold winter day with an exceptionally high barriers of the control o

HOOKER'S "ICONES PLANTARUM"

THE recent issue of the fourth part of vol xx of the third series, with a total of two thousand plates. the third series, with a total of two thousand plates. This useful, and now indispensable, publication was commenced by the late Sir William Hooker in 1837, and the first volume was dedicated to the late George Bentham, who is described in the dedication as an "ardent promoter, not less by his patronage than by his writings, of botany and horitculture "Sir William Hooker started the "Icones' to illustrate some of the numerous novelties in the collections which were pouring into his herbarium from various parts of the world, especially from the southern hemisphere, at that period. With a few exceptions by Harvey, Gardner, and others, the drawings and descriptions were by Hooker himself, and a volume, containing one hundred plates, appeared annually, or nearly so. The first series closed with the fourth volume in 1841. At this date the founder was already Director of Kew Gardens, and he continued the work to the tenth volume, which terminated the second series Two or three of the later volumes of this series were illustrated by the then rising botanical artist, W. H. Fitch. In the tenth volume we find a dedication of the whole ten volumes to George Bentham, in much the same words as the first. This was in 1854. After an interval of thirteen years, the third series was commenced, under the editorship of Dr. J. D. (now Sir Joseph) Hooker, and G Bentham, D Oliver, and J G Baker were contributors Mr Bentham, we believe, financed the undertaking This, the eleventh believe, financed the undertaking This, the eleventh volume, was not completed until 1871, but it is a most interesting volume, illustrated by Fitch, and containing among other things many of the endemic plants of St The second volume of this series, the twelfth of the whole, was also illustrated by litch, and is valuable for the figures of curious new genera founded by Bentham and Hooker when elaborating their "General Plantarum

On the completion of this volume, in 1876, a difficulty arose, consequent on the retirement of the artist, though there was no actual interruption in the appearance of the parts. But it was impossible to replace an artist like Fitch. Indeed, the only alternative was to train a person to do the work. This was not so easily accomplished; there were failures, and so high a standard of excellence has not since been reached. Nevertheless, the present artist gives as good drawings as could be expected from dred, hat specimens, and the botancal details are usually

as full as is necessary, if not all that could be desired.

Since Mr Bentham's death, in 1884, the work has proceeded with greater rapidity, and is now appearing at the rate of a volume per year. It is now published at the expense of the Bentham Triasses, and sold at about half could be the proceeding the process of the country of the process of the

' Of a fund bequenthed by Bentham for the advancement of totanical science.

contain a large number of Chinese novelties. One part of the last volume is devoted to the Stapelia of South Africa. The seventeenth volume is wholly devoted to new ferns, and the first volume of what it is intended to call the fourth series will consist entirely of orchids Three parts of this have already appeared

MY DEAR PROF. TAIT,—In Part IV of your "Foundations of the Kinetic Theory of Gases," 1 "Foundations of the Kinetic Theory of Cases, vou take exception to the manner in which Van der Waals has introduced Laplace's intrinsic pressure K into the equation of virial "I do not profess to be able fully to comprehend the arguments by which Van der Waals attempts to justify the mode in which he obtains the He repeats a good deal of Laplace's capillary work, in which the existence of a large, but unknown, internal molecular pressure is established, entirely from a statical point of view He then gives reasons (which seem, on point of view. He then gives reasons (which seem, on the whole, satisfactory from this point of view) for assum-ing that the magnitude of this force is as the square of the density of the aggregate of particles considered. But his justification of the introduction of the term are into an account already closed, as it were, escapes me. He seems to treat the surface-skin of the group of particles as if it were an additional bounding-surface, eveiting an additional and enormous pressure on the contents 1.ven were this justifiable, nothing could justify the multiplying of this term by (v - B) instead of by v alone. But the whole procedure is erroneous. If one begins with the virial equation, one must keep strictly to the assumptions made in obtaining it, and consequently everything con-nected with molecular force, whether of attraction or of elastic resistance, must be extracted from the term E(Rr)

With the last sentence all will agree, but it seemed to me when I first read Van dei Waals's essay that his treatment of Laplace's pressure was satisfactory, and on reperusal it still appears to me to conform to the requirements above laid down As the point is of importance, it may be well to examine it somewhat closely The question is as to the effect in the virial equation of a mutual attraction between the parts of the fluid, whose range is small compared with the dimensions of bodies, but large in comparison with molecular distances

In comparison with molecular distances
The problem thus presented may be attacked in two
ways. The first, to which I will recur, is that followed
by Van der Waals, but the second is more immediately
connected with that form of the equation which you had in view in the passage above quoted.

In the notation of Van der Waals (equation 8)

 $\frac{1}{2} \mathbf{Z} m \mathbf{V}^2 = \frac{1}{2} \mathbf{Z} f \rho - \frac{1}{2} \mathbf{Z} \mathbf{R} r \cos (\mathbf{R}, r),$

where V denotes the velocity of a particle m, which is situated at a distance r from the origin, and is acted upon by a force R, while (R, r) denotes the angle between the directions of R and r. The intermediate m It represents the effect of such forces, f, as act mutually between two particles at distances from one another equal to ρ In the summation the force between two particles is to be reckoned once only, and the forces accounted for in the second term are, of course, to be excluded in the third term.

In the present application we will suppose all the mutual forces accounted for in the second term, and that the only external forces operative are due to the pressure

Ed. Trans , vol xxxvi , Part 2, p. 261

of the containing vessel No one disputes that the effect of the external pressure is given by

$$= \frac{1}{2} \mathbf{R} \mathbf{r} \cos (\mathbf{R}, \mathbf{r}) = \frac{1}{2} \mathbf{p} \mathbf{r}.$$

so that
$$\Sigma mV^2 = \gamma b \gamma + b \Sigma u \phi(a)$$
.

if with Laplace we represent by $\phi(\rho)$ the force between two particles at distance ρ . The last term is now easily reckoned upon Laplace's principles. For one particle in the interior we have

$$\frac{1}{2}$$
 $4\pi \int_{-\infty}^{\infty} \phi(\rho) \rho^3 d\rho$,

and this, as Laplace showed,1 is equal to 3K. The second summation over the volume gives 3K1, but this must be halved. Otherwise each force would be reckoned twice Hence

$$\frac{1}{2}\Sigma mV^2 = \frac{1}{2}pv + \frac{1}{2}Kv - \frac{1}{2}(p + K),$$

showing that the effect of such forces as Laplace supposed to operate is represented by the addition to \$, the pressure exerted by the walls of the vessel, of the intrinsic In the above process the particles situated pressure K near the surface are legitimately neglected in comparison

With those in the interior

Van der Waals's own process starts from the original form of the virial equation-

where R now refers to the whole force operative upon any particle, and it appears to me equally legitimate am particle, and it appears to me equally legitimate for all particles in the interior of the fluid X vanishes in virtue of the symmetry, so that the reckoning is limited to a surface stratum whose thickness is equal to the range of the forces. Upon this stratum act normally both the pressure of the vessel and the attraction of the interior fluid. The integrated effect of the latter throughout the stratum is equal to the intrinsic pressure, and, on account of the thinness of the stratum, it enters into the equations in precisely the same way as the external pres-sure exerted by the vessel The effect of Laplace's forces is thus represented by adding K to p, in accordance with the assertion of \ an der Waals

I am in hopes that, upon reconsideration, you will be able to admit that this conclusion is correct. Otherwise, I shall wish to hear more fully the nature of your objection, as the matter is of such importance that it ought not longer to remain in doubt
Believe me yours very truly,

RAVINGH L'Abbaye de St Jacut-de-la-Mer, September 7

THE French Association for the Advancement of Science met at Marseilles on September 17, under the presidency of M. P. l' Dehérain, who chose as the subject of his address the part played by chemistry and physiology in agriculture. The meeting comes to an end to-day. There were general excursions on Sunday to Arles, and on Tuesday to Aix, and it is proposed that to morrow, the 25th, there shall be a final excursion to the Mediterranean coast

THE Congress of German Naturalists and Physicians was opened at Halle on Monday by Prof His, of Leipzig. The meeting was attended by 1215 persons, including many dislinguished foreign physicians and men of science and 280

THE Helmholiz celebration, deferred from August 31, is now fixed for November 2. After the ceremony the delegates and others will dipe together at the Hotel Kaiserhof

See also Phil May . Uctober 1800, D Tur

By the death of August von Pelzeln, which took place on the and inst. at Ober Dobling, near Vienna, Europe has lost one of her foremost ornithologists. He had been in failing health for some years, and had recently retired, after forty years' service. from his post of Custos of the Imperial Museum at Vienna, where he had charge of the collections of Mammalia and birds. Von Pelzeln will be always celebrated in the memory of zoologists by his important essays on the collections in the Vienna Museum, but his most enduring work will be found in the famous "Ornsthologie Brasiliens," wherein he gave a detailed account of the collections made by the great traveller Natterer in the early part of the present century. Only last year he published n the Annalen des & k naturhistorischen Holmuseums, an account of the formation of the collections of Mammalia and birds in the Imperial Cabinet, which is a very valuable historical record The amiability of his character and his great knowledge of zoology had raised up for Von Pelzeln a host of friends in every country, and the news of his death will be received with wide spread regret.

A REUIER telegram from New York announces the death of Prof William Ferrel, the meteorologist.

THE ROYAL Academy of Sciences at Labons send official notice of the decease of their Secretary, José Maria Latino Coelho, who died on the 29th uit. at Cintra, at the age of sixty-six Besides his Secretaryhip of the Academic Royale des Sciences, Prof. Coelho held the post of Director of the Mineralogical Section of the Museum at the Fedile Polivechnique de Labonare.

THE death of M. Wilken, the well-known Dutch ethnologist, has excited much regret in Holland, where his scientific work was greatly appreciated. He was forty-four years of age, and had spent some time as a Government official in the Dutch East Indies, where he had ample opportunities for carrying on his favourite studies.

PROF. K GOESEL has been appointed Professor of Botany in the University, and Director of the Botanic Garden at Munich, in the place of the late Carl v. Nageli

THE Photographic Society of Great Britain announce the holding of an exhibition, which will be open from September 28 to November 12

TRE most interesting part of the Royal Horticultural hocsety?
whibition on Tuesday was a series of the so called camprorous
and insect eating plants. It was hoped that the dapplay of
this series would tend to correct some very musiscen ideas
which are said to be current on the subject. According
to Mr. Weathers, the Austanta Secretary of the Royal Horticultural Society, some persons, relying on what they have
heard, will assert that "these plants can easily dapose of a
beefiteak or mutton chop if their digestive organs are in thorough
repair."

This annual meeting of the Federated Institution of Mining Engineers was held on Tuesday at the Mano College, Brimmeham, and was attended by about 120 members Mr. T. W Embleton, of Leeds, persided In the report it was stated that the Council had not yet undertaken any special inquiry consected with the objects of the Institution, but their attention had been directed to the question of safe explosives for use munes, the mechanical ventilation of mines, and other subjects by the permitten of the Durham Coulcowner? Association and duced in mines by roburite, tottle, and guapoweder had been printed in the Transactions. The North of England Institution had appointed a committee to examine and report upon the pro-offiled "famelees" explosives for use in mines. A paper selecting the geology of the Brimmigham dutriet was read by

NO. 1143, VOL. 44]

Prof Lapworth. A paper was also submitted by Mesers. W. F. Clark and H. W. Hughes, in which the local method of working the third coal was described to the visitors, and the peculiarities of the South Battforkine coal-fields were described in technical detail. Mr. Arthur Sopwith supplied some similar information with reference to the North Satisfordines portion of the coal-field. These two papers were state as a read, and the water of the satisfaction of the coal-field.

A REPORT for the year ending May 3t last, by Mr. G. I. Swanston, the Assistant Secretary of the Marine Department of the Board of Trade, upon the colour tests used in the examination of candidates for masters' and mates' certificates in the British mercantile marine has been issued as a Parliamentary paper The number of persons who presented themselves for examination for masters' and mates' certificates of competency under Form "Examination 2" amounted to 4688, being an increase of 26 over the previous year, when 4662 were examined. In the past year 31 persons were rejected for their inability to distinguish colours, as compared with 23 rejected in the previous year. The number of persons examined in colours only under Form "Examination 26" amounted to 601 Of these, 32 were rejected, being an increase of over 1.8 per cent. as compared with the previous year, when, out of \$39 candidates examined, 29 were rejected. A few of those who failed to pass succeeded afterwards in satisfying the examiners. One man, who, on March 3, described a green card as drab, drab as green, pink glass as salmon and green, standard green as blue, bottle green as red, and neutral as green, passed a fortnight later, having apparently learned to distinguish the colours in the intervening period The mode of conducting the colour-test examination described in the Report for the year 1887 is still in operation, but Mr Swanston notes the fact that the whole subject of colour-vision and the best mode of conducting the examinations are now being investigated by a Committee appointed by the Royal Society.

On his return from Japan, sixteen years ago, Prof Rein, the well-known authority on Japanese art and industry, planted in the Botanical Gardon at Frankfort some specimens of the lacquer-tree (Rhus vernici/era), from which the Japanese obtain the juice employed in the production of their famous lacquer work According to the Times, there are now at Frankfort thirty-four healthy specimens of the lacquer-tree, 30 feet high and 2 feet in girth a yard from the ground; and the young trees, which have sprung from the original tree's seed, are in a flourishing condition. It seems to be proved, therefore, that the lacquer-tree is capable of being cultivated in Europe, and it only remains to be seen whether the juice is affected by the changed conditions The Times says that, to ascertain this, Prof Rein has tapped the Frankfort trees, and has sent some of the juice to Japan, where it will be used by Japanese artists in lacquer work, who will report on its fitness for lacquering. In the meantime, some of the most eminent German chemists are analyzing samples of the juice taken from the trees at Frankfort. and samples of the juice sent from Japan, and should their reports and the reports from Japan be favourable, it is probable that the tree will be largely planted in public parks and other places in Germany In course of time a skilled worker in lacquer would be brought over from Japan to teach a selected number of workmen the art of lacquering wood, and in this way ut is hoped that a new art and craft may be introduced into Enrope. Prof. Rein has been conferring with the authorities at Kew as to the results of his experiment,

THE Hydrographic Department of the Admiralty has just published full details of the determinations of the latitudes and longitudes of six stations on the west coast of Africa—namely, Port Nolloth, Mossumedes, Benguela, St. Paul de Loanda, Sao. Thomé, and Bonny. The observations were made in 1880 by Coamstder T. F. Pullen, R. N., and Mr. W. H. Fuslay, under the direction of Dr. Gill, of the Cape Observatory Whols sationed at Bonny, Commander Pullen succurabed to malarant fever, and Dr. Gill has aunce taken charge of the reductions. The observations would not have been possible but for the courtery of the Officials of the Eastern and South African Telegraph Company, who placed their cables at the disposal of the

Meptunua for July gives a description of the fingate Scilla, set apart by the Italian Government for the hydrographic exploration of the Medicieranean, and of its scientific fittings and instruments. By the end of september the Scilla was expected to be at work along the Italian possession in the Red Sea, investigating the fauna and flora, and the temperature at different doubth.

DR. A ALCOCK, the Surgeon Naturalist of the Marine Survey of India, is able to give a most favourable report of the work done in natural history on board the Investigator during the year ending March 1, 1891 The deep sea researches made great progress. Not only has the work of collection been much more successful since the use of the reversible trawl and wirerope, but the collections themselves are becoming better arranged, so that should it ever be decided to report upon them. group for group, in systematic detail, there will be abundance of material all sorted ready to the hand. Dr Alcock is most anxious that such a report should at some time be undertaken . for apart from the Marine Survey of India nothing whatever, he thinks, is likely to be made known of the life of the depths of the Indian Seas, and of the physical and chemical characters of the deposits now being laid down on the hottom of those seas Further, there are good reasons for supposing that an economic return would follow from the careful investigation of the littleknown semi-bathylisal fauna of Indian waters, and from a comparison between it and the semi-bathybial faunce of the Mediterranean Sea on the one hand and the Japanese Seas on the other

We have received from Messas Philip and Son a new orrey for finding roughly the pointions of the sun, moon, and planess for any hour of the year, and their times of raing, southing, and setting. In general appearance it resembles their well-known planusphere, but, in addition, it is provided with two index aring graduated in degrees of declination—one for the sun, and the other for the moon or planet. The operations are simple, but the instructions given becarely do state to the arrangements but the instructions given becarely do state to the arrangements accompanism to the orient seal to the control of the contro

A BOIANICAL Club for California has been instituted under the presidency of Dr. H. W. Harkness

WE learn from the Botanical Gazette that Prof J M Coulter has been spending the wamer in studying the Cactacess of the borders of the United States and Mexico, under the direction of the Department of Agriculture at Washington; and that are expedition has been organized to investigate the florn of Mount Orisaba, Mexico, under the superintendence of Mr H. E. Seaton.

A QUARTERLY Review of Geological Science in Italy will shortly appear at Rome, edited by Sigg M. Cermenati and A. Tellini.

MR. CHARLER TODU, in his Report on the Rainfall in South Australia and the Northern Territory during 1890, says that without doubt "the feature" of the year was the extraordinary rainfall (especially in the first three months) over the eastern and north-eastern portlons of the continent, which continued throughout the whole year, more or less, in New South Wales, and, whilst giving that colony the wettest year on record, caused some stations to register over 100 inches

LUE Pilot Chart of the North Atlantic Ocean for September states that the most important storm of the month was the hurricane that devastated the island of Martinique on the evening of the 18th, causing the loss of 378 lives The storm seems to have been of comparatively small diameter, and it probably originated south-east of the island, which it passed directly over, on a west north-west track towards San Domingo It recurved over the eastern Bahamas, and thence moved north-east close to Bermuda , where at noon of the 27th the wind blew with hurricane force from north-north west. The weather, the same as in this country, was unsettled and rainy over the North Atlantic generally, especially off the Atlantic coast of the United States, and a considerable amount of fog has been reported. A submarine earthquake was experienced at 10h 30m a m on August 23, in latitude 36' 44' N , longitude 59° 47' W , by the s.s. Robert Harrowing Captain Hughon reports that a strange commotion of the sea increased until the decks were filled with water. At th. p m the sea suddenly fell calm

COLORADO apparently intends to be well represented at the great Cheago Exhibition Besides the inimeral, agricultural, and educational ethibits, the flora and fanns of the biate will be shown in great completeness. Already more than 1000 specimens of plants have been pressed, nearly 200 varieties of fruit have been deplicated in wax, and more than 2000 species of muccis have been monited.

RETURNS have been collected in Prussia, showing the extent to which buildings belonging to the State, or entitled to State subsidy for rebuilding or repair, were damaged by lightning from the year 1877 to 1886 The number of buildings to which the returns relate is 53,502 Of these, 264 were struck during the period in question, or about five for every 1000 buildings in tea years, and in 81 cases a fire resulted The following facts, given originally in the Reichmanzeiger, are reproduced in the current number of the Board of Trade Yournal -Of the 264 buildings struck, to7 had towers, and in six cases only the tower escaped being struck. Of the total number of buildings struck, fifteen were fitted with conductors, and of these latter only one building escaped injury. In two cases the conductor was injured, and on one occasion the lightning passed from the conductor to an iron water pape. In five cases they were so constructed as to be either dangerous or useless, in six cases they were not struck at all, being inadequate for the size of the building, from which it will be seen that conductors are a safeguard against lightning only when carefully constructed and repaired, and hited in numbers according to the size of the building which it is intended to protect The amount of injury wrought by lightning on the 53,502 houses was, on the whole, inconsiderable, being only 1,136,683 marks (£56,831), or 4306 marks (£215) for each casualty, or 21 marks (a guinea) per building in ten years, that is 2 1 marks (about 21) per building per annum

Soas parts of Australia seem to be admirably susted for the growth of the olive Mr. Pennegal Prompson, of Doolies, rays in a recent report that 700 olive trees planted in that district are robust and healthy, and that they produce spleduid oil. He strongly recommends the planting of the olive around vineyard and homesteads for shade and shelter, and to give a pietrareque appearance to the rural home. Apart from the making of oil, the believes it would pay handsomely to grow olive berries to feed pigs alone. Last writer the page at Louise (about 80 cm), they had no other food for upwards of two months, and throve amandagly, their skins having a peculiar shining appear ance, characteristic of samula theory will feel.

TORACCO is being cultivated with much success in the German part of New Guinea, and is said to be better than the tobacco produced in Sumaria. It is expected that there will be a great lacrease in the amount grown during the coming year

ACCORDING to M. d'Amagher, the Russian correspondent of the Monde Economique, a central Agricultural Insuinte is to be established in Russia. It will include several sections—agricultural, geological, meteorological, botanical, chemical, and technological, and branches will be formed in the provinces.

USUSIALLY fine atmospheric effects were produced by the clear weather of the Mediterrasean during the month of July. According to the Mediterrasean Naturealut, the new monthly periodical issued in Malla, the phesonenon of irregalar diffraction was especially shown by the raising of the line of sight to such an extent that objects at great distances, at other times completely concealed from view, were apparently raised so much above their true position as to be clearly discernible from the shores of Malla and Good. The cliffs of the coast line, and the undilatory control of the mountains of Stelly, were to be seen dattactly with the naked eye on July 12 and 12, while the out-lines of Eina view to be sloped against the clear arms sky Although more than 100 miles away, the form of the mountain was perfectly recognizable.

THE honey of the Maila bees has long been noted both for the spenty and for its delicious flavour. A writer in the Mediterranean Naturalist says the flavour is largely due to the extensive crops of sulla, (clove); that are annually ranged throughout the talands, from which the bees derive the largest proportion of their matternal. It is estimated that to collect one pound of honey from clover, 64,000 heads of clover must be deprived on feeting, and 3,75,000 wrists must be made by the bees.

SOME excellent directions for the collection, preparation, and preservation of birds' egg, and nests have been put together by Mr C Bendire, and published by the United States Nationa Museum He begins his counsels by telling the would-be collector that unless he intends to make an especial study of oology, and has a higher aim than the mere desire to take and accumulate as large a number of specimens as possible regardless of their proper identification, he had better leave nests and eggs alone The mere accumulation of specimens, Mr Bendire points out, is the least important object of the true cologist, The principal aim of the collector should be to make careful observations on the habits, call-notes, song, the character of the food, mode and length of incubation, and the actions of the species generally from the beginning of the mating season to the time the young are able to leave the nest

AT one of the meetings of the Wellington Philosophical Society in 1885. Sir Walter Buller, F R S, exhibited a series of the so-called wandering albatross, and expressed his belief that there were two species under the common name of Diomedea exulant, one of them being highly variable in plumage, and the other distinguished by its larger size and by the constancy of its white head and neck But, although that was his conviction, he did not feel justified in setting up the new species and giving it a distinctive name until he could produce incontestable evidence of its existence. From a paper read by him before the same Society in February last, and published in the new volume of the Transactions of the New Zealand Institute, we learn that he had lately had an opportunity of examining sixteen beautiful specimens of both sexes and of all ages, and that as the result of his study of these specimens he had no hesitation in speaking of a new species "It is undoubtedly," he says, "the noblest member of this group, both as to size and beauty, and I have therefore named it Diomedea regra " He exhibited before the Wellington Society a series of both species, and in the course of

NO. 1143, VOL. 44]

some remarks on them stated that they keep quite spart from one another on their breeding-grounds, and do not commingle "except when sailing and soaring over the mighty deep, where a community of interest and a common pursuit bring many members of this great family together."

In the paper in which he deals with the species called by him Diomedes regia. Sir Walter Buller refers to a remarkable characteristic of the wandering albatross-a characteristic which has been carefully studied by Mr Harris At a certain time of the year, between February and June-Mr Harris cannot exactly say when-the old birds leave their young and go to sea. and do not return until October, when they arrive in large numhers. During their absence the young birds never leave the breeding-ground Immediately after the return of the old birds, each pair goes to its old nest, and, after a little fondling of the young one, turns it out, and prepares the nest for the next brood. The deserted young ones are in good condition, and very lively, frequently being seen off their nests exercising their wings; and, when the old birds come back, a young bird will often remain outside the nest and nibble at the head of the old one, until the feathers between the beak and the eye are removed, and the skin made quite sore. The young birds do not go far from land until the following year, when they accompany the old ones to sea When the young are left in the nest at the close of the breeding season, they are so immensely fat that Sir Walter Buller thinks they can subsist for months without food of any kind. Captain Fairchild has de scribed to Sir Walter from personal observation the coming home of the wandering albatross, and the peremptory manner in which the young bird in possession is ordered to quit the nest. so as to make room for its successor

THE habits of the kingfisher (Hakyon vagans) formed the subject of an interesting paper read some time ago by Mr. J W Hall before the Auckland Institute, and now printed in the Institute's Proceedings He raised the question, Is it customary for the kingfisher to capture live birds? Last winter he saw one with a live white eye in its mouth. The tree the kingfisher was perched upon was not many yards distant from him, and he distinctly saw the little wings fintter convulsively as the kingfisher was preparing to beat its prey against the branch. So it could not have been a dead bird casually picked up Perhaps this, he said, was an application of the lex talsons, for, besides being mercilessly persecuted by the small boys with their catapults, the kingfisher was not infrequently captured by the common hawk But sometimes the hawk does not come off best. One day at Parawai (Thames) a hawk sailed round the bend of a hill, followed (accidentally, he supposed) by a kingfisher There at once arose a great outcry, and the hawk came again in sight, bearing the kingfisher in its talons. But, nothing daunted, the kingfisher with its pickage of a bill pegged away at the breast and abdomen of its captor to such good effect that the hawk was glad to liberate its prey, whereupon the kingfisher flew away apparently but little the worse for the encounter, and carrying with it, he need hardly say, the full sympathy of the onlookers. A friend of the author had seen a kingfisher dive under water to escape the pursuit of a hawk.

MK J CRAWFORD, State Geologus and Mineralogust of Noncasqua, visited in 1838 the Amerique Indians, from whose ancesteral name "America" may have been derived, and he has talled submitted to the Botton Society of Natural History some interesting notes about them. They occupy a hilly region is the gold-mining part of the district of La Libertad, Nicasqua, where these are "true fissures," each containing gold in sufficient quantities to give profits to the mine and mill owners now "operating" them. A few welted masses of gold, weighting from half an onnee to two onnees each, plered with

holes, and in form supposed to have been made and used as ornaments before the Spanish occupation, have been discovered in the district; and Mr. Crawford repards it as a fair inference that the Amerrique Indians who dwelt in that part of Nicaragua at the time of its discovery by Columbus, September 1502, picked up and occasionally mined, melted, and used gold for sacred or ornamental purposes The Amerrique Indians are usually well formed, 6 feet 6 inches 106 feet 8 inches tall , and they are active, and appear to be strong and healthy Nevertheless, they are dying out rapidly. Probably not more than 275 or 300 of them are now living. They live in dim pathless forests, and their occupation is to find in the woods various species of trees (Siphonia, Castilloa, &c.) They deeply scarify these, collect the exuding emulsion, and separate the contained elastic ("India") rubber, and this "India" rubber they carry on their backs more than 100 miles to sell to merchants in Rama or at the mouth of Rio Matagalpa They have cleared some patches of ground, and plant corn by making holes in the soil with pointed sticks. They believe that with allied tribes they had in very ancient times a mighty prophet or cacique, who appeared suddenly, full grown, in their territory, and that to him many tribes of Indians gave allegiance. The impalpable form of this ancient chief has been seen by very old Indians proudly walking and gesticulating on the top of Mesa Totumbla. He is buried in, or returns by day to, a deep cavern in this Mesa (a mass of gnesss), and he indicates, by gestures, that he will one day collect the Indians into a great army, and lead them in person to many victories Mr Crawford found his way into the cavern. and discovered in it three cranis of Indians with other bones of their bodies. These were sent in 1880 to the Paris Exhibition. and were afterwards transferred to the U.S. National Museum A few crude beads or ornaments, evidently earlier than the Spanish occupation of Nicaragua, were also found.

THE following are the arrangements for lectures during october at the Royal Victoria Ilali —October 6, Prof 1 Iludoon Beare, the steam engine, with experiments, October 13, Rev Cason Browne, the invasion of hagdand and Battle of Hassings, with illustrations from Bayeux tapestry, October 20, Mr. J. R. Green, flowers and their helpers, and October 27, Rev. E. Bill, the Channel Island

AT a meeting held last year by the students of the Kindergarten department of the New York College for the Training of Teachers, various papers were read on the principles and methods of the Kindergarten These papers have now been stude at one of the educational monographs of the New York College. Miss A Brooks, who contributes an introduction, for the introduction of the Kindergarten yeares into its school, for the introduction of the Kindergarten yeares into its school, and a movement begin by the New York Kindergarten Avocution at desimed, she thinks, "to accomplish great things for the neglected children of the city."

"EGYPTIAN SCIENCE," by N. E Johnson, is the title of a work which will shortly be published by Messrs Griffith, Farran, and Co.

TRE Durham College of Science, Newcastle-upon-Tyse, has issued its Calendar for the season of 1891-92. The College represents the faculties of science and engineering in the University of Durham, and thus constitutes an important portion the University of the north of England. But it does not restrict its work to science and engineering; it fulfils all the functions of a University College.

THE following works will shortly be published by Messes. Crosby Lockwood and Son — "The Mechanical Engineer's Pocket-book of Tables, Formule, Rules, and Data," a handy

NO. 1143, VOL. 44]

book of reference for daily use in engineering practice, by D. Kinnear Clark, "The Metallurgy of Argentiferous Lead," a practical treatise on the smelting of silver lead ores, and the refining of lead bullion, including reports on various smelting establishments, and descriptions of modern furnaces and plants in Europe and America, by M Eissler: "Engineering Chemistry," a practical treatise for the use of analytical chemists, engineers, iron masters, iron founders, students, and others. comprising methods of analysis and valuation of the principal materials used in engineering work, with numerous analyse-, examples, and suggestions, by H Joshua Phillips, "A Handbook of Brewing," a practical treatise for the use of brewers and their pupils, by Herbert Edwards Wright; "Condensed Machines," a selection of formula, rules, tables, and data, for the use of engineering students, science classes, &c , in accordance with the requirements of the Science and Art Department. by W. G. Crawford Hughes, "Milling," a treatise on machines, appliances, and processes employed in the shaping of metals by rotary cutters, including information on making and grinding the cutters, by Paul N Hasluck, with upwards of 300 engravings, "Star Groups," a student's guide to the constellations, by | Ellard (rore, with thirty maps, "Lessons in Commerce," by Prof R Gambaro, of the Royal High Commercial School of Genoa, edited and revised by James Gault, Professor of Commerce and Commercial Law in King's College. Landon

AMONG the books announced by Messis George Philip and Son are the following -"Delagoa Bay its Natives and Natural History," by Rose Monteiro, with 20 original illustrations, after the author's sketches and from the natural objects. by A B and E C Woodward, "Paraguay its History, Commerce, and Resources," by Dr. E Bourgade, with 13 illustrations and a large coloured map, "Makers of Modern Thought, by D Nasmith, Q C , "The Teacher's Hand-book of Sloid," as practised and taught at Naas, by Otto Salomon, Director of the Nats Seminarium, with over 130 illustrations, "Hughes's Class-book of Modern Geography," an entirely new and completely revised edition, much enlarged by J Francon Williams . "Geography of the British Colonies and Foreign l'ossessions," by the Rev. J P. Faunthorpe, new and revised edition, "Systematic Atlas," for higher school and general use, a series of physical and political maps of all the countries of the world, with diagrams and illustrations of astronomical and physical geography, specially drawn by E. G. Ravenstein, "The Handy Volume Atlas of Astronomy," a series of 72 plates, with notes and index, by Sn Robert Stawell Bull, I R S . "The Handy Volume Atlas of London," a series of 64 maps, with notes, compendium, directory, and complete "Atlas of Modern Geography," new and enlarged ındex , edition

THE additions to the Zoological Society's Gardens during the past week include two Macaque Monkeys (Macacus cynomolgus) from India, presented respectively by Mr G. H. Sas-e and Mrs Gregorey; two Sykes's Monkeys (Cercopithecus albigularis) from East Africa, presented by Mr. F Pardage, one Mozambique Monkey (Cercopithesus sufo viridis), one Garnett's Galago (Galago garnetts) from East Africa, one Blotched Genet (Genetta (1.72 ma), one Ostrich (Struthio camelus) from East Central Africa, presented by Mr. Freith Anstruther, one Coypu (Myopotamus coypus) from South America, presented by Mr Spencer H. Curtis, one Golden Eagle (Aquila chrysacius), European, presented by Mr Herbert Bray, one - Sand Grouse (Pterocles ----) from South Africa, presented by Mr. Max Michaelis; two Trocary Pigeons (Columba trocary) from Madeira, received from Dr F J Hicks; one --- Elap: (Elaps ---) from Australia, presented by Mr E II. Meek,

one Rhomb-amarked Snake (Psammophis shombeatus), four Crossed Snakes (Psammophis crucifer), one Hygian Snake (Elaps hygra), two - Snakes (Dasypelts: scabra) from South Africa, presented by Messrs Herbert Melville and Claude Beddington: one Smooth Snake (Coronella lanus), two Common Snakes (Transianatus natrux) from Oxfordshire, presented by Mr A W. S. Fisher, one Otter (Lutra vulgaris) from South Wales, received in exchange, two White-iailed Sea Eagles (Haliačius albicillay's) from Norway, three Indian Python (Python molurus) from India, deposited, one Macaque Monkey (Macacus cynomolgus) from India, one Pardine Genet (Genetta pardina) from West Africa, purchased, one Vinaceous Turtle Dove (Turtus sunaceus), heed in the Menagerie.

OUR ASTRONOMICAL COLUMN.

LIGHTNING SPECTRA -Mr W E Wood, of Washington, LIGHTNING SPECTEA—Mr W E Wood, of Washington, has continued his observations of lightning spectra for the purpose of determining the origin of some of the lines previously recorded by him (NATURE, vol. xlu p 377). The results is that he is now able to say, in the Suderal Messenger for August : he is now able to My, in the Suderal Messenger for August p-"Lightining spectra present but the characteristic lines of oxygen, hydrogen, nitrogen, and earbonic acid, and—what was puzzling to me—the line of the vapour of sodium. The absorp-tion bands which I find in lightining spectra. I think might be produced by the moisture in the air, a large quantity being present during thunderstorms." It is suggested that the sodium line owes its presence to the existence of meteoritie dévirs in the atmosphere

A NEW ASTEROID. -The 315th asteroid was discovered by Charlos on September 1.

THE INTERNATIONAL GEOLOGICAL CON-GRESS WASHINGTON MEETING

THE fifth meeting of the International Geological Congress, being the first ever held in America, was held at the Columbian University, Washington, from August 2610 Septem ber 1, with an attendance of axxy or seventy foreigners, from Austria-Hungary, Canada, Chihi, France, Germany, Great Britain, Mexico, Peru, Rosmania, Russia, Sweden, and Switzerland, and about two hundred members from the United States The papers and discussions were generally in English, though French and German were to some extent spoken. French has

been the language of all the previous Congresses

Profs James Hall and James D Dana were elected Honorary Presidents, and J S Newbery Acting President Owing to the absence of the latter, the chair was filled in turn by everal of the Vice-Presidents

FIRST DAY—After the election of officers, as nomunated by the battern, Frof Joseph La Conte, as senior Vice Fresident, the state of the content of the conte afterwards carried out-manely, to discuss classification of the Pleutocome rocks, of correlation, and of map notation. He pleutocome rocks, of correlation, and of map notation. He pleuty of the former and the simplicity of the latter. He then considered some points in American geology—(-i) The general continuity of the record. (3) The prevalence of exercise continuity of the record. (3) The prevalence of exercise continuity of the record. (3) The prevalence of exercise continuity of the record. (3) The prevalence of exercise continuity of the record. (3) The state of the record of th uptilted strata. The Sterra Nevada is an illustration. (4) Ex-tensive lava floods, covering areas from 10,000 to 100,000 square miles in extent, and from 2000 to 4000 feet deep No such floods are found elsewhere. Those of India are the nearest approximation, but in Europe the lava beds are small and much cut up. (5) The great continental movement, commencing in the later Tertiary, and terminating in the beginning of the Onternary, which has caused changes of level amounting to 2500 or 3000

feet on both sides of the continent (6) The ice-sheet of the glacial feet on both sides of the continent (6) The ice-sheet of the glacuit open was first and most completely demonstrated in America.

Oher addresses were delivered by 8th, Ziubbart, Charman of the soft of the control of the special control of the special control of the special control of the Coological Survey of the United States; Prof. Hughes of England, Prof. Gaudry of France, and Mayor Powell, Chief of the Geological Survey.

SECOND DAY—The entire by wes eccepted by a fusions on elamification of the glease II between deposits. Prof. T. C. Chamberlin opened the discussion by stating that classification might he made on three grounds (1) structural, (2) chronological; (3) genetic. The first was very easy, being an obvious extremely difficult, and could not be accurately made till after a full determination of the third. He accordingly proposed the following general classes: (1) formations produced by the direct action of Pleistocene glaciers; (2) formations produced by the combined action of Pleistocene glaciers and accompanying durest action of Pleutocene glacers; (2) formations produced by the combused action of Pleutocene glacers and accompanying glacuit formage; (3) formations produced by disease accompanying glacuit formage; (3) formations produced by those accompanying produced by douting ice derived from Pleutocene glacers; (5) formations produced by shore acceptance according to the Pleutocene temperature, but independent of glacers action., (6) glaco-divarial deposits under the peculiar conditions of glacuiton. This paper was decussed very throughly Frof T McK Hughes pointed out that the classification suggested by Frof T McK Hughes pointed out that the classification suggested by Frof T McK Hughes pointed out that the classification suggested by Frof and the superior of the control of the c

preting geological processes. Any primary geological classifica-tion must be genetic lle discussed in detail the following scheme of classification of Plestocene deposits -

Classification of Pleistocene Formations and Land Forms A. Aqueous

- Below base level. Marine
- b Estuarine Lacustral
- 2 At base level a Littoral b Marsh
- Alluvial (certain terraces, &c)
- 3 Above base level
- a Torrential
 b Talus (including playas).
- I Direct (Chamberlin's Class I) 2 Indirect (Chamberlin's Classes II to V., in part).

 C Aqueo Glacial (Chamberlin's Classes II to V., in part).

 D. Folic (Chamberlin's Classes II to V., in part).
 - Volcanic 1 Direct
 - a Lave sheets b Cinder cones
 - Tuffs, lapilli sheets, &c.
 - 2. Indirect
 - a. Ash beds b Lapilli sheets
- Prof Chamberlin, in closing the discussion, said that there was great difficulty in applying a chronological classification, and that such a classification might even act as a barrier to observation and to the recognition of the truth. Chronological classification is the ultimate goal of glacial studies, but it is something for which we are not as yet prepared. Red, outdated sub-soils are not developed in northern latitudes. Organic deposits between glacial layers are abundant in the West, but do not belong to a single horizon. Many facts of crosion and

physical geology indicate that the Glacial epoch in America was widely differentiated and of long duration How many distinct periods it embraced we do not as yet know Prof. Cope said an abundant tropical fauna is found in the "Equius beds," which, if they be of interglacial age, indicates at

this time a very warm climate. This fauna is succeeded by a truly boreal fauna. In this is contained material for a chronological subdivision of Pleistocene deposits

THIRD DAY -The President announced as the subject for discussion, the correlation of geological formations. Mr Gilbert opened this discussion by presenting a general

classification of methods of correlation Strata are locally classified by superposition in chronologic sequences. Geologic correlation is the chronology of beds not in visible sequence For convenience in discussion, methods of correlation are classed in ten groups, of which six are physical and four biotic

Physical Mitheds of Correlation

(1) Through visible continuity. The outcrop of a bed is traced from point to point, and the different parts are thus correlated one with another. (2) Strata are correlated on account of hthologic similarity

This method, once widely prevalent, is used where the distances are small (3) Correlation by the similarity of lithologie sequence h

great and important use where the localities compared fall within the same geologic province, but is not safely used in

within the same geologic province, but is not sarely used in passing from province to province (4) Physical breaks, or unconformities, have a limited use, especially in conjunction with other methods. The piactice of employing them in the case of localities wide apait is viewed ith suspicion.

(5) Deposits are also correlated with their simultaneous rela-

(3) Jeponis are asso coreined with their similarity and physical event—for example, a breach with the temperature of the physical event—for example, a breach with the sahaqueous deposit, and alluvial, intorial, and subaqueous deposits standing in proper topographic relation. In the Plentocene, glacial deposits are widely correlated with reference to a climatic episode assumed to arise from some general cause.

to a climatic episode assument to arise from sourc general cause (6) Deposits are correlated through comparison of changes they have experienced from geologic processes supposed to be continuous Newer and older drift deposits in different regions are correlated according to the relative extent of weathering are correlated according to the relative extent of weathering and erosion, induration and metamorphism afford presumptive evidence of age, but yield to evidence of other character. Meta-morphism holds prominent place in the correlation of pre-Cambrian rocks where most methods are mapplicable.

These physical methods are qualified by the geographic dis-tribution of geologic processes of change and of geologic

Biotic Methods of Correlation

(7) A newly-discovered faims or flora is compared with a standard series of faunas and floras by means of the species it holds in common with them severally (8) It is also compared by means of representative forms, or

through genera and families

(7a) and (8a) These comparisons are strengthened if two or more faunas in sequence are found to be systematically related to

the faunas of a standard series. (9) Two faunas or floras otherwise related are compared in

age through their relation to the present life of their localities.

This method was applied by Lyell to Tertiary rocks

(10) Faunas are correlated by means of their relation to character suredes their relation to chmatic episodes taken in connection with station. For ex-

climatic episodes taken in connection with station. For ex-sample, boreal shells found in latitudes below their present range are referred to glacial time In general the limitations to accurate correlation by biotic methods arise from the facis of geographic distribution. Cor-relations at short range are better than those at long range.

relations at short range are better this those at long range. Blotte correlation by means of fossils of different kinds may be a superior of the state of the sta

NO. 1143, VOL. 447

unimportant Among animals, those which are marine, lacus-trine, and land animals may be distinguished. Of these classes marine invertebrates are most valuable for purposes of correlation. The vertebrates change rapidly, but are frequently altogether wanting For instance, no vertebrates occur in the Alpine beds corresponding in age to those which contain the mammalian fauna of the Paris basin. In certain lacustrine deposits invertebrates may be absent, and in such cases the

vertehrate fauna is the surest guide

Baron de Geer emphasized the importance of a numerical comparison between different species The actual counting of

individuals in a given formation is of great value

individuals in a given normation is of great value. Prof. Marsh expressed his agreement in general with the conclusions communicated by Prof. von Zittel, but would give special weight to vertebrate fossil. In the Mesozoec and Tertiary beds of the Kocky Mountains he had found that the vertebrates offer the aurest guide for correlation. This is in part because invertebrates are either wanting or are lacustrine most characteristic vertebrate genus in each which is confined exclusively to it. He presented in outline of such classification brought down to date, with a section to illustrate vertebrate life in America

Mr C. D Walcott spoke of the value of plants for purposes

For general correlation

of geologic correlation
Prof T, Mck Hughes spoke of the present and growing tendency towards a natural classification
The evidence is com-

tendency towards a natimal dewification. The evidence's com-plex, and includes v considerable warmey of diverse relations and the property of namony are cited an example from his own experience, or how an identification of synchronous formations might be made over a wide area through a union of physical and hotic

ernous Mr W J McGee remarked that in the coastal plain of the United States physical correlation alone is employed. The bases accord with those outlined by Mr. Gilbert, with certain minor modifications and an important addition, as follows—

Visible continuity For local discrimination Lithologic similarity . Similarity of sequence Physical bicaks viewed as inand correlation For correlation throughdices of geography and topoout the province graphy Relation to physical events, including continental move For correlation with conments. tiguous provinces transportation of materials, land sculpture, &c

Homogeny or identity of origin

By correlation upon these bases the physical history of a considerable fraction of the continent may be so definitely asceratained as to permit fairly accumite mapping of the geography, and even the topography of each episode in continent growth After these episodes are clearly defined, and the fossils found in the formations are studied, it will be possible definitely to as-certain the geographic distribution of organisms during each episode, then palmontology may be placed on a new and eprsode, th higher plane Prof. W.

higher plane Prof. W. M. Davis showed that it was possible to decipher geological history not only through the records of deposition, but also by processes of degradation. As an example of this method he explained a topographical section from the city of New York westward. In this we have evidence of the existence New York westward. In this we have evidence of the existence of an ancient jeens/tain, or base-level lowland of Cretacous age. This surface was subsequently elevated (more toward the west than toward the cast) at the end of Cretacous, or at the beginning of Tertiary time. It has since been dissected by the excavation of more recent valleys. The Iludson Valley lowland was cited as on example of this recent dissection

Prof E. W Claypole considered that the different methods of geologic correlation differed very greatly in their value. It is improbable that the plant or mammalian record will ever equal in its perfection that of the marine invertebrate fauna. The marine fauna is to the geologist what a primary triangulation is to the geodesist It marks out the main divisions, which are subsequently further subdivided through the aid of other fossils.

such as plants and vertebrates

Prof C. R. Van Hus spoke of the methods of correlation employed for pre-Cambrian rocks, which occur in widely separated areas and are devoid of fossils. Physical data only are available for correlating these formations Experience has are available for correlating these formations. Experences has belown that, among all physical methods, unconformity us by far the most important. Other physical enteries, such as the edge which is the most important. Other physical enteries, such as the edge which is the substitution of single areas, but cannot be safely used in identifying synchronous formations in widely expected used in identifying synchronous formations in widely expected of geological gas that tested the screenite substitution of pre-Cambrian rocks. The researches of Pumpelly and other in the eastern United Stites have demonstrated that Shirman, Devonian, and even Carboniferous deposits might become, Devonan, and even Carboniterous deposits might become, under certain physical conditions, as highly crystalline as much more ancient rocks of the West For this reason it has been found necessary to abandon such terms as Huroman and Armennanan Evidences of life are not lacking in pre-Cambrian rocks, and it is to be hoped that the paleontologist will succeed in differentiating several separate formations below the Cambrian, as the Cambrian itself was differentiated from the base of the

FOURTH DAY -Prof L W Hilgard laid stress upon the importance of the abundance or scarcity of species in the importance of the abundance or scarcity of species in the correlation of strata. He thinks some quantitative estimation of the species should be made. He is of the opinion, also, that, as compared with insurine fauna, plants have but little value for purposes of correlation owing to their local distribution, their accidential proximity to water, transportation, and preservation. Plants can be so used only after large areas are worked over. Prof. Lester F. Warl continued the discussion. It de-

weloued two of the more general principles of correlation by means of fossil plants, as follows —

(1) That the great types of vegetation are characteristic of the

great epochs in geology This principle is applicable in comparing deposits of widely different age when the stratigraphy is indecisive. For example, even a small fragment of a Carboniferous plant proves conclusive. sively that the rocks in which it occurs are palæozoic, or a single dicorvledonous leaf proves that they must be as late as the Cretaceous

(2) That for deposits not thus widely different in age, as, for example, within the same geologic system or series, ample material is necessary to fix their position by means of fossil

Neglecting this principle has led to the greater part of the mistakes of palacolotanists, and has done most to bring palacobotany into disrepute. (reologists have expected too much of them, and they, in turn, have done violence to the truth in them, and they, in turn, have done violence to the truth in attempting to satisfy extravagand demands. On the other hand, where the matterial is ample, fossi plants have often corrected the mistakes of strattgraphical goodquits, and solved problems concerning geologic age, which seemed impossible of settlement by any other class of evidence.

Prof. Henry S. Williams land stress upon the relations of species to the conditions of deposition.

species to the condulous of deposition. The abandance of a species wares with environment, and a study of correlation should embrace a study of these condutions. Sendatones deposited near short may have a faunt different from that of a family and the study of the conductions are short may have a faunt different from that of a family and the study of the conduction. The age of beds should be determined by comparing species of the same genera rather than by comparing those of different genera. There are centered shandance which exhibit great variability in their characters; outside of these centres the species exhibit varieties which may be called extralimital, and which are not typical though they have often been

published as types.

Prof. Charles Barrois said that there was no general basis, either biologic or litherogic, for the correlation of the pre-Cambrian rocks of Europe with those of North America; even the terms applied to these rocks were liable to be misanderstood. divisions used in France cannot be correlated with those now used in the United States General correlation cannot, as vet. used in the United States General correlation cannot, as yet, be hased upon nonconformittes; autopay is the only basis upon which a comparison can be instituted. He pointed out certain parallelsms. Fetween the histories of the crystalline schists of America, as illustrated by Mr. Pumpelly, and the guesser rocks of Brest, where the Cambrian slates are altered to gneisses of Archavan aspect, while the alternating fossiliferous quartzites archanged to crystalline quartz. Geologists must see the beds together in order to reach a common understanding of the crystalline rocks

Prof E. D. Cope discussed the question from a general point of view with especial reference to the value of vertebrates for purposes of correlation, particularly for inter continental correla-tion. He pointed out that there is a marked difference in the tion He pointed out that there is a marked difference in the present verebrate faunas of continents, and that the variation of such forms must be sought in vertical rather than in horizonial ranges. Such study shows that we have had invasions of a given region by a fauna from without; for example, a South American fauna invaded North America at one time and then retreated, while a North American fauna once invaded South America, and traces of it still remain in that country He is in-clined to believe that certain vertebrate forms did not spread over the earth from a single place of origin, but that originated at different places upon the earth We have parallel-ism in separate places, but the parallelism is defective in the I aramie

Mr G K Gilbert was of the opinion that many methods of correlation must be used. He doubted the trustworthiness of the He thought the abundance and scarcity of fossil forms comparable with lithologic differences, and considered the simple occurrence of a species as valuable for purposes of correlation as its abundance

FIFIH DAY - Subject for discussion map-colouring and cartography.

Major J W Powell exhibited charts illustrating the colour system used by the U S Geological Survey, explained the methods of using the colours, and gave the reasons for them

7	he	colours assigned to	rocks of different ag	es are as follows
		Period	Penad colour	Mark
	1	Neocene	Orange	N
	2	Eocene	Yellow	E.
	3	Cietaceous	Yellow green	K
	ă.	lura-Trias	Blue-green	1
	5	Carboniferous	Blue	ç
	ŏ	Devonian	Violet	D
	7	Silurian	Purple	Š
_	8	Cambrian	Pink	€
•	9	Algonkusn	Red	Ã

The colours are used to designate geologic periods, patterns The colours are used to designate geologic periors, patterns of these colours designate formations; minor divisions are designating formations can be indefinitely enlarged, but follows a designating formations can be indefinitely enlarged, but follows a definite system.

Mr Joseph Willious showed that in the scheme described by Major Powell the colours were not evenly dustributed through

major rowen in colours were not evenly diarnoused inrough the chromatic scale. Prof C. R. Van Hise pointed out that Archean rocks are shown by a brown underprint, and that metamorphic rocks of known age are given the colour of the corresponding unaltered

Major Powell explained that it was not attempted to select

Mayor Powell explained that it was not attempted to select-closurs equally distributed through the chromatic scale, but to down sequely distributed through the chromatic scale, but to Mr. II. M. Cadell asked why black and gray were not used, Mayor Powell replied that bute was used in place of the dark shades for the Carboniferous; that dark colours are milledning and the colours are milledning to the colours and the colours are sent and colour and Textifury as well as in the Carboniferous, Mr. Chrostife found the black colour very inconvenient, because offers made the details of the map covered by such colours offers made the details of the map covered by such colours

illegible
Mr. H. M. Cadell said that the maps of the Geological Survey of Great Britain were coloured by hand, and that the system used by the U S Geological Survey could not for this reason

Major Powell explained that the U.S. Survey system is very conomical when the colour patterns are transferred to atones. Prof. T McK Hughes thought it very difficult to devise a scheme that will meet the demands of everyone. Some refe ence must be had to the permanence of the colours, the readi-ness with which they can be applied, and the distinctness with which they show what is desired. He thinks the fittest scheme must envenue

In the afternoon, hrief lectures were given by Prof Chamber lin, Mr Gilbert, Major Powell, and Mr Emmons upon the geology of the country to be traversed by the long excursion

SIXTH DAY -A Committee on International Bibliography

was appointed.

The Secretary announced that Messrs, Golier and Schmidt convey an invitation from the Swiss Government to hold the sixth International Congress, in 1894, in Switzerland, Mr Golier delivered an address in which he presented the invitation, Goher delivered an address in which he presented the invitation, and the Congress unanimously accepted it. The following Swiss members were appointed a local committee, with power to add to their number and to appoint the time and place of meeting viz. Menzer Heim, Renevier, Lang, Balter, Schmidt, and Golier On the motion of Prof Purpuelly, a vote of thanks was passed to the Swiss Government and delegation. It is thought that Berne will be selected as the place of meeting

The Geological Survey of Russia sent an invitation to hold the seventh Congress in Russia. The Car joined in the invitation. Prof. Tschernychew made the formal presentation of the tion. Prof. Tschernychew inside the formal preventation of the subject to the Congress. A vote of thanks to the Survey and the Car was passed, and the Secretary of the Congress was authorized to send a despatch by cable, transmitting the vote. The President of the Congress, Prof. 1 e Conte, delivered a

brief closing address, summarizing the work of the session, and after passing several votes of thanks the Congress adjourned

THE SOCIETY OF FRIENDS OF ASTRONOMY AND COSMIC PHYSICS

THE Society of Friends of Astronomy and Cosmic Physics founded May 19, 1891, has been formed with a view to the organization of systematic activity and co-operation in research in the subjects named It is mitended to embrace, chiefly, workers in astronomical science in Germany, Austro Hungary, Switzerland, and other neighbouring countries, and natives of these countries in the colonies and elsewhere Members of other nationalities are, however, offered a welcome

The head centre of the Society is Berlin. The subscription

The head centre of ine 50-tery is never an experience of the formal form

not be issued at regular or stated intervals.

These communications will form at present the only direct publication of the Society, until it is formed on a more substantial financial basis and consists of a larger number of members (in the first four weeks the number rose from 50 to over 100) Contemporaries are at liberty to horrow any matters of

too) Contemporares are at liberty to horrow any matters of interest contended in the Society's communications, of course acknowledging the source from which they are derived acknowledging the source from which they are derived as the source of the Meteorological and Photographic Societies, but, never theless, endeavouring to preserve the closest annity and co opera to with the relief Societies.

The Astronomische Gesellschaft, founded in Germany in 1863, is regarded by the new Society as the principal Society, whose office it is to loster astronomical research throughout the whole earth. The new Society bears the same relation to this international association as do those Astronomical Societies already established in England, France, Russia, and North

The principal object of these smaller societies is to collect observations made in the largest possible number of districts, inasmeet as researches in astronomy and cosmic physics are very largely dependent on the state of the weather, and the relation of the place of observation to the phenomena in the heavens.

In the new Society the following branche, of work have been selected:—(1) Observations of the sun; (2) of the moon and selected:—(2) Observations of the sun; (3) of the moon and selected:—(2) Observations of the sun; (2) of the polar of the selected selec

respondence, noted brance meetings, and preserve the connection which bunds each group to all the olbers

The Society will sendeavour to further the organization of all these researches, not merely by the publication of communications and by correspondence, but also by advice and aid in the providing of Apparatius, expectally of sinishes optic, electric, and

The statutes of the Society will be sent post free on applica-tion to the Secretary, Herra Cand C Witt, Berlin, N.W.,

Invalidenstrasse 57

The President of the Society is at present Prof Dr R I elements Filhes, Berlin, W., Wichmannstrasse 11a

minin runes, periin, w., wicomannistrave lia
The Committee consists of the six members presiding over
the everral group of research
The Librarian of the Society is Herr Dr. P. Schwahn,
Berlin, N. W., Invalidensinasse 57, and the Treasurer to whom
subcomptions should be sent, Herr Rendant Brack, Berlin, N W , Invalidenstrasse 57

A MONGS1 a gathering of small Serpulids, &c., received from Mr. Sinel, of Jersey, I find some interesting little worms related to the Sabellida. They build a thin membraneworms related to the Sabelinds. They build a thin membrane-like tube, about one seventicth of an inch in diameter, coaled externally with flat translucent particles of sand. Its lower end externally with flat translucent particles of sand its lower end is closed, and embedded in sponge or other growths, but the upper end is free, and, when the head of the inmate is protraited, stands about a quarter of an inch high in the water. On this head are two branching tuffs, each having five branches. based with a double row of long clinated hizments. When all are fully expanded they curve backwards, and cover an area of about one tenth of an inch in diameter. The hranches decrease in size from the inner to the outer pairs, and at the back of the longest but one in each tuft, near its base, is a chocolate or



brown coloured vesicle. The two smallest branches curve back-wards round the mouth of the tube, and keep up a constant

wants found the mouth of the tupe, and keep up a constant whipping of flicking motions, upon the retreat of the animal, the mouth of the tube not only instantly closes flaily and tightly collapse of the sides, but the tube tittle, beginning at the tup, proceeds to coil up like a spiral spring, looking very much like a young Fern-found. This y, of course, an effectual protection against the intrusion of enemies, and the coiling and uncoiling, which I have witnessed many times, is a most curious

Fig. 1 shows the branchial tufis expanded Fig. 2, tube beginning to coil up. Fig. 3, tube partly coiled up—a process which is

sometimes continued much further. I do not know whether this annelid has previously been noticed or described, but, if so, I shall feel obliged to any of your readers who can refer me to ARNOLD T. WATSON. Sheffield, August 10

GEOGRAPHY AT THE BRITISH ASSOCIATION.

THERF was at least one very satisfactory feature about the Geographical Section at the Cardiff meeting. It has been the practice in all the other Sections to appoint as Presidents men who have gained a high reputation as specialists in their own wno nave gained a high reputation as specialists in their own departments. For some remon this practice has not been followed in the Geographical Section True, in past years we have had such men as Murchison, Markham, Galton, General J. T. Walker, but too often the President of this Section, while em-Walker, but too often the President of this Section, while emi-nent as a soliding or a colonial Covernor, or as a Society man, has known as much about geography as "the man in the street". It must be admitted that this has in part arisen from the fact that scientific geographers in England could have been consided on the fingers of one hand. Happily, through the recent efforts of the Royal Geographical Society, thriving to be the case, and when the Chairs at Oxford and Cambridge, and the other in-fluences which are at work, have had time to produce results, fluences which are at work, have had tune to produce results, geography, non ore often of its aspects, may become as much of a career in legisland as it is in Germany. If was regarded as to one cettent a trumph, and an exercise of what is coming, that the President of the Section at Candiff was a geographer pure the conscientific configuration of the Section at Candiff was a geographer, and the conscientific configuration of the Section at Candiff was a geographer, in the conscientific configuration of the United Kinglion (where he has been naturalized for many years), and in a geographer, in the best sense of the term, he is not surpassed. If was natural that in his address, he should deal with the progress of the subject in which he is master. If his address, which contensibly supect in which he is master. His address, while ostensibly dealing with eartography, really showed the growth of our coception of the earth's surface, and indicated the most profitable aspects in which we may deal with that department of knowledge whose business it is to investigate dge whose business it is to investigate

Amid a good deal that was trivial, and not withstanding the

isual modicum of sensation, Section E did some solid work at Cardiff The fact is that the only incident which could be Mrs. French Sheldon and the appearance on the platform of regarded as sensational was the appearance on the platform of Mrs. French Sheldon, evidently suffering greatly from the accident with which she met on her return from Klitmanjaro But Mrs. Sheldon was able to tell us some things about the people in Last Africa that had never come within the ken of the male traveller Moreover her account of the curious crater lake male traveller Moreover her account or the cursous craser saxe Chala, at the south-east foot of Kilmanapro, was a real contribution to geographical knowledge. With immense difficulty abe and her companion descended the denne vegetation which covers the precipitous sides of the crater, and navigated the tray lake on a raft, which was continually in danger from the awarms of crocodiles. Mrs. Byshop (Miss. Isabella Brd) was anything crocodiles Mrs Bishop (Miss Isabella Bird) was anything but senational. With perfect calmines and clearness she gave obtained to the control of the control

Mr. John Coles's paper on the art of observing showed how Mr. John Coles a paper on the next of conserving snowed now comparatively easy it is for any man of average intelligence, and even punit in the higher classes of our schools, to acquire a knowledge of the use of the more common survey instruments. An excellent paper on the homology of continents was read by Dr Hugh Robert Mill, who showed that in many respects to by Dr. Hugh Kobert Mill, who showed that m many respects there as a generakable family likeness among the continents, there is a general continent of the same influences. Mr. Silva White, in his paper on the comparative value of African lands, attempted, by a statistical method, to indicate the lines of least resustance against the European domination in Africa. Mr. Miller Christy gave an elaborate and highly instructive paper on the absence of trees from prairies, his conclusion being that the main cause of the treelessness of American prairies has been forest fires. The paper was highly suggestive, showing, as it did, that if proper measures were taken were nour great deserts might be made to blossom as the rose

The greater part of one morning was devoted to a discussion

on acclimatization, introduced in a valuable paper by Dr Robert Felkin. The author showed that there are two schools of thought, the one regarding acclimatization as impossible, the other more sanguine and pronouncing it possible. Probably the truth will be found to be a mean between the two. In considering the subject, it is necessary to specify, first, the various nations who are to be acclimatized, and secondly, the places where they are to be located. As regards the first point, the national characteristics, habits, customis, and environment insuit be taken into account, and with respect to the second, the nature of the country, its climatology, its inhabitants, their mortality and endemic diseases must be brought under survey. The next point is to classify the various European nations, and it becomes evident that they can only become readily acclimatized in the national characteristics, habits, customs, and environment must temperate zone, where climatic and other conditions are approximately ikin to their present habitat. In reference to Europeans becoming acclimatized in the tropics, what are those factors becoming acclimatized in the tropics, what are those factors which prevent it, or which must be overcume before its possible? They are as follows hest, cold, damp, various endemic discusses, expectably maintain, and those constitutional conditions discussed in the control of rendering acclimatization possible for Europeans in tropical countries? It must be said that both Dr. Felkin and those who followed him in the discussion occasionally lost sucht of the real point at issue The adaptation of a European to tropical conditions for a few years is one thing, the acclimatization of a race in a climate totally different from that which has been its inheritance is another. About the former there need be now no difficulty what scanty experience we have leads to the con-clusion that the latter is practically impossible. What we really want are experiments continued over three or four generations

generations
Colonel Holdich, of the Indian Survey, gave some valuable
hints in his paper on the application of Indian geographical
survey methods to Africa An outline of the methods proposed
may be summarized as—(1) The adoption of a rapid system of may be summarized as—(1) The adoption of a rapid system of trangulation along the most important lines for first survey (2). The extension of a graphic system of mapping from these lines of the proposed of the state of the sta respect, though there may be no mmediate cause for action. There is, however, a great necessity for a topographical acquantance with the boundaines adopted. Only a small portion of being defined by rivers, &c. If would appear, then, advantageous to commence transgulation along the boundary lines thus; however, to far a national or international question, and ance might very well be expected, and Imperial resources drawn upon for enzying it out. (1) What are there resources? (2) What is the nature of the survey we ought to bindly 197. Replying to (3) and (3), we find that if a continuous and comprehensive scheme is to be adopted, with unity of design for all the been done as yet which would least that it is not to be more of the continuous and comprehensive scheme is to be adopted, with unity of design for all the been done as yet which would least that necessarily out or the continuous and comprehensive scheme. respect, though there may be no immediate cause for action. scattered distracts of the African colonial system, nothing his been done as yet which would assait as in carrying out our scheme. This scheme should be largely borrowed from expe-sion of the same as the same as a second of the same as to what extent largerial survey resources might be atlined during the processes of laying out the preliminary lines of transquistion. From this transgulation the extension of looperably would there-after probably depend on private enterprise. Then followed a carried out by astress of I float, of the value of such native labour, and of the possibility of rasing survey establishments!

The subject of reform in our Ordnance Survey was again introduced this year in an elaborate paper by Mr. H. T. Crook, who was strongly supported by a number of speakers. Mr Crook pointed out many defects in the large-scale maps. Some of them are notoriously behind date; they are issued in a most

inconvenient form: they are far too expeasave, they are difficult to obtain notated of London. The Committee of this Section sent a strongly worded resolution to the Council of the Association, recommending, among other things, that the Directorship of the Suivey, instead of being merely a staff appointment, should be made a permanent office. Unfortunately, the resolution submitted to the General Committee omitted this remaining the committee of the Committee o

amount to much

Mr James Thomson's paper on photography applied to
exploration contained suggestions of great practical value. He
showed the value of the camera, not only in recording geographical
features and types of people, but even as an adjunct to regular

The subsect of geographical education was introduced in a short paper by Mr. J. Scott. Active, who no pole of the results which had followed the action initiated by the Royal Geographical Society a few years ago. Advances have been made in many directions. Chairs have been established in Oxford and eliminate of the subsection of geography and of its contraction of the subsection of geography and of its contraction of the subsection of the s

Geographical Society in Cartiff lailed. Among other papers worthy of mention were two by Colonel H. Tanner, of the Indian Survey—one on a new method of Bar-Subtense surveying, and a second on some of the principal tribes of the Himalayas.

MECHANICS AT THE BRITISH ASSOCIATION.

N Section 6, Mr. Secreta Brown.

N Section 6, Mr. Secreta Brown.

In the locality are the secretary and the secretary with the president. There was an average list of papers, but the discussions were not so fall as as sometimes the case in this Section. As a consequence, the attituge were got through with more than whole bisumests of the Section 4 as consequence, the attituge were got through with more than whole bisumests of the Section was completed by two of other on the Tuesday of the meeting. The President's address was given as usual on the Thursday, and referred to mechanical details in connection with mining. In character with the meeting it would not be seconded, Prof. Obsborne Reynolds proceeded to reed the third Report of the Committee appointed to investigate the action of waves and currents on the both and forebitors of estuaries by developed the committee around the second to the second the second of the committee appointed to investigate the action of committee around the second to the second of the second o

experiments, more especially without the also of the congruence with the Report was illustrated with the Report was illustrated with the Report of the Report of the Report of the Report of the Stevenge of a neighbouring district, and thus relieve the River Eaff of some of its present fool buries. The sever, no doubt, is a mentronous engineering notable point as that the Taff has to be crossed severe times, and thus as effected by means offmerted syphons which go below the river bed. The principle, of course, is not new The chief interest was in the speech made by Mr. Baldwin Laban druing the discussion, in the course of which the spraker esclaimed the sarth should be returned to the earth Mr. Latham is of opinion that what is taken from the earth should be given to the sea. The occase, he says, was given to the enquerer as a

receptacle of sewage—presumably among other functions. Moreover, Mr Latham tells us that it is more profitable to put sewage in the sea than to keep it on the land. It encourages the growth of marine fauna, and it is, so Mr Latham says, a well known fact that where there is most sewage there are most fish. As there were no "faddrits" present, Mr Latham had it all his cays was.

courage the growth of marine fauna, and it is, so Mr Latham says, a well known fact that where there is most swage there says, a well known fact that where there is most swage there Latham had it all his own way.

Mr L F Vernon Harcourt's speep described the engineering operations carried on in the neighboring River Usk and the harbour of Reveryor. This pass, gain, did not him forward harbour of Reveryor. The pass again, did not him forward necessing on the now fairly well recognized lines of increasing the third fact. The Athernethy spoke in the discussion, and fold the total flow. Mr, Athernethy spoke in the discussion, and fold the

any points of partnealar novelty. Mr. Vernon Harcourt is proceeding on the now fairly well recognized linas of increasing, the total flow. Mr. Abernethy spoke in the discussion, and told the Section how he had once resigned his position in connection with the Swannes Harbour Board because it was proposed to canalate the river. The question might, we think, have been contained the river. The question might, we think, have been with the proposition of the proposition of the contraction of the work of the proposition of the proposition of the proton of the proposition of the proposition of the proton of the proposition of the proposition of the proton of the proposition of the proposition of the proton of the proposition of the proposition of the proton of the proposition of the proposition of the proton of the proposition of the proposition of the proton of the proposition of the proposition of the proton of the proposition of the proposition of the proton of the proposition of the proposition of the proton of the proposition of the proposition of the proton of the proposition of the proposition of the proton of the proposition of the proposition of the proton of the proposition of the proposition of the proton of the proposition of the proposition of the proton of the proposition of the proposition of the proton of the proposition of the proposition of the proposition of the proton of the proposition of the proposition of the proposition of the proton of the proposition of the proposition of the proposition of the proton of the proposition of the proposition of the proposition of the proposition of the proton of the proposition of the

with the rivers referred to--low far volume of ebb and flow, as Mr. W. Key, of Glosgow, described the system of ventilation and heating which he had nitroduced in the Vistoria Infrinary. Glosgow Here, spain, we have no new theories enmeated, lower than the contract of t

assuming reavitation of the teached day's stiting. Firday, August 21, the child of the teached day's stiting. Firday, August 21, the child of the teached day's stiting, firday, August 21, the child of the child of

Prof. W. Robinson next read a paper on petroleun engines it would appear that this description of motor is hiely to come to the front, if one may judge from the fact that their manifacture is being taken up by some important engineering firsts. Priestiman Brow, of Itali, have been at work on the problem for the last year or two, and it is chiefly of the Prestiman engine that Prof. Robinson speaks. Croseley Bros., of Manchester, who have made such a brilliant success with the Otto gas engine.

have now taken up the subject, and are making an oil engine; whilst the big agricultural engineering firm, Hornsby's, of Grantham, have also turned their attention in this direction. Grantham, have also turned their attention in this direction. There have also been efforts under by foreign engineers. A petroleum engine works generally on the same principle as a gas engine, but the chief trottle, we believe, hitherto has been to get over the clogging of parts. This supplies the chief feature in the Priextuan design, in which there is a spray maker specially designed to get over this trouble. A jet of oil is fair. broken up by compressed air, and the spray is then further mixed with air, heated by the hot products of combustion. To mixed with air, heated by the hot products of combination. To cleanance the air it is drawn through cotton wood, which naturally has to he renewed from time to time. The proportions of air and oil vapour rea earranged to give an exploitive charge, and a regular explosion is obtained every cycle by means of an electric spark. The cylinders are water-jucketted. Messar, Priesman have fitted a pair of their oil engines into a small launch, which is said to have answered well. Whether pertoleum used with the proposed of the control of the contro explosively in an engine affoat will ever our tried but very imperfect servant steam-as the gas engine is superseding the deam engine in so many positions ashore—is a very open question. Certainly it is a great temptation to get rid of the heavy and bulky boiler, which takes up so much room in a boat, but much remains to be done before we can arrive at the more logical method of generating heat energy in the place where it has to be used — It may be that that terrible exhaustion of our has to be used It may be that that terrible exhaustion of our coal-fields, about which we heard so much at the meeting of the Association, will be indefinitely postponed by the using of petroleum or other hydrocarbon as a source of motive power. But that is another story

Mr. Beauchamp Tower described some improvements in de-tail which he has introduced in the design of that beautiful piece tail which he has introduced in the design of that beautiful piece of mechanism by which he has severale to us, by means of gyrocopically controlled hydraulic gear, a steady platform at rea, power by compressed air D. William Anderon described his revolving water punifer, and Mr. Faija gave a long account of many joints in connection with Portland cement. These were all the papers read on Finday.

On Saturday there was to meeting in Nection G, and Monday of the paper of the papers of the

was, according to custom, devoted to electrical matters. Mr W H Preece opened the proceedings with a long paper, or rather lecture, on the London and Paris telephone, in the course of which he was enthusiastic upon the success which had been obtained. He is sanguine that before long we shall be able to talk between London and Berlin. Of course, he improved the talk between London and Berlin Of course, he improved the occasion by invisting on the necessity of metallic returns, a point upon which all will agree with him except shareholders in tele-phone companies Naturally, also, Mr Preece did not fail to hint how much better off the British public would have been had telephone exchange been left in the hands of the Post Office No doubt, if all the telephones were now transferred to Mr Preece's guidance, we should sooner have metallic returns, and Christian patience would be less exercised, but the question may ause whether we should have had any telephones at all now if Covernment monopoly had not been broken through Mr Preece as the controlling factor, we should answer "Ye But there are other sorts of Government officials than Mr

Mr Bennett's paper on the telephoning of great cities referred mostly to the arrangement of details of exchange

mostry to the arrangement of details of exchange Prof. G Forber read a long paper, in which he gave an account of recent progress in the use of electric motors. It was of an interesting nature, and dealt largely with the advance that has been made in America. We trust Mr. Forbes is better acquainted with Transatiantic electrical practice than he is with one branch, at least, of British practice, for when he said, as we understood him, that there are no electrical cranes in England, he was certainly wide of the mark
Papers by Mr N Watts, on electric fire-damp indicators, as

by J. A Timmis, on electric lighting in trains, were also on the

On Tuesday, August 25, Section G held its last sitting, and there was a varied selection of papers. The first was a contribution by Mr. A R Bennett, in which he advocated a system of house-to-house parels distribution, which would certainly be very convenient if it could be carried out. He proposes tunnels under the street with injunture electric railways. That would be a difficult higher to firrange in any of our cities, the space being so occupied by gas and water-pipes, severa, electric

wires, hydraulic mains, and many other things, were the tunnels wires, nyurauin mains, and many other things, were the tunnels simply to be run straight away with only stations at distant points, but Mr Bennett proposes to make this a house-to-house service, each subscriber having his own siding. The tube would be rectangular, with two lines of rails one above the other. By means of semaphores at the central station, worked electrically by the passage of the train, so that the operator can always tell where the train is, and by further electrical connection he is able to shunt the train into the subscriber's own siding. one subscriber wants to send a parcel to another, he procures a truck, and despatches this through the tunnel to the central station, from whence the operator forwards it to the right address. There is even an arrangement for unloading automa-tically, and the truck can then be brought back by the operator without the intervention of the subscriber. The idea is fasci-

tically, and the truck can then be brought hand by the operation without the intervention of the shapener. The least is factive without the intervention of the shapener. The least is factive that the least of the of the screw-propeller was essentially non-scientific. He made his chief discovery in an endeavour to do one thing, but pro-duced the reverse result. When Griffith first used the spherical

duced the reverse result. When crimin nest used the spherical boss, he was trying to produce a retarding effect, but found, on trial, that he had added greatly to the efficiency of the screw. Mr Beaumont also read a paper on the screw-propeller He detenbed a method of reversing the direction of thrust by means of feath.rmg.rbidee, on the well-known Bevis principle. The advantages claimed were that, as the engines and screw would be always running in one direction, there would be no momentum of moving parts to be overcome when it was desired to go from of moving parts to be overcome when it was desired to go from ahead to astern, or vice verid, and therefore there would be less danger of breakage of the mechanism. The proposal was somewhat rogicily handled in the discussion which followed, but we think that Mr Beaumont fairly held his own in his reply. The most, valid objection appeared to be that of Mr Heard, who pomted out that the pressure on a given area of the blade was pointed out that the pressure on a great act of the by no means constant throughout each revolution, and the disturbance would cause the joints of the mechanism to wear. For this reason there would be introduced an undesirable and even dangerous play on the pins after the apparatus had been in use some time

A paper upon non-conducting coverings for steam-boilers having been read, the business of Section G was brought to a close with the usual votes of thanks.

ANTHROPOLOGY AT THE BRITISH ASSOCIATION.

THE proceedings began with the President's address, after which Prof. R. K. Douglas read a paper on the social and religious ideas of the Chinese as illustrated in the indeographic characters of the language. After a short introduction, showing that the Chinese designaphic characters are preture writings, the three transportations of the profession of the contract of the profession of the contract of the profession of the profession of the domestic life were illustrated by a number of ideographic dief where illustrated by a number of ideographic dief which will be a the profession of the contract of the profession of the contract of the profession of t

with marriage; and the evidences of pastoral as well as of agricultural habits among the people. The paper concluded with references to the counage of the country as described in the ideograms employed to represent its various forms.

ideograms employed to represent its various forms.

The following papers were also read on recent progress in
the analysis of vowel sounds, by Dr. R. J. Lloyd; family
life of the Haidas (Queen Charlotte Islands), by the Rev
Charles Harrison; and the Report of the North-Western Tribes of Canada Committee. This last is again the work of Dr Franz Boas in the interesting ethnological field of British Franz Boas in the interesting ethnological field of British Columbia II consists of two parts, the first being devoted to the Bilquila, a people inhabiting a limited tract in the vicinity of Dean Inlet and Bentinick Arms, the second dealing with the physical characteristics of the tribes of the North-west coast

physical control of the U.S. Bureau of himology Fepton fax Muller then made some remarks on the work of Mayor J. W. Powell, Director of the U.S. Bureau of himology He and that he had just received the proof-these of a most unsportant publication on the classification of the Indian language. spoken in America. It is a splendid piece of workmanship from Major Powell, the indefatigable Director of the American from Mayor Powell, the indefatigable Director of the American Bareas of Ethnology. The publications of that Bareas coast amongst the most valuable contributions to anthropological sceneos, and they reflect the highest credit, not only on Major Gordenset, which has swactioned a very large outlay for the prosecution of these studies. There was stim in the way these volumes are brought out, and most of the papers, contained in them surper the student with that confidence which can only be produced by honest, conscientious, and truly scholarities work. Our American frends have precreed that it is a motional duty to preserve as much as can still be preserved of the languages and thoughts of the industrial to preserve as much as can still be preserved of the languages and thoughts of the indigenous races who were the earliest dwellers on American soil. They know that the study of what Prof. Max Muller ventured to call intellectual geology a quite as important as that of terrestrial geology, and that the study of the lower strata contains the key to a right understanding of the higher strata in the growth of the human mind. Coming generic tions will call us to account for having allowed the old world to vanish without trying to preserve its records. People who ask what can be the use of preserving the language of the Mohawks forget what we would give if some scholar at the Mohawka forget what we would give if some echolar at the time of Cato or Casar hal winten down, what many could then easily have done, a grammar of the Ertuscan Inspanger of the Casar half with the case of the Casar half with English colonies Loid Granville saw that such an undertaking was a national duty, and that the necessary funds should be con tributed by the various colonies. What a magnificent work this would have been. But while the American Government has pushed forward its work, Lord Granville's scheme expired in the pigeon-holes of the Colonii Office. America may well be proud of Major Powell, who would not allow the treasures colonii. lected by various scholars and Government officials to moulder and perish. He is a true enthusisst, not a man of mere impulse and good intentions, but a man of sustained effort in his work He deserves the hearty thanks of the Association, and more

He deserves the heatty thanks of the Association, and more separally of the Anthropological Section.

The whole of Friday morning was occupied by a paper by the Marquess of Bute, on the language of Teneriffe. The difficulties in the study of the language are due to the fact that the abordinanal words have been collected from All the Islands without indicating their several origins, so that the Teneriffe words were not at first easily distinguished hitherto have held three opinions as to this language. The first

hitherto have held three opinions as to this language. The first is that of Dr. (List, who considered the language American (and the people African), the second, advanced by Sir Edmund that the third helds that the Tenefiffiam were of Aryan ongue. Dr. Edward B. Tylor read a paper on the limits of savage feiglion. It has alred become left by the inquiries of anthropologists that the world-famous Great Spirit of the North American Tolians arose from the teaching of the Jesuit mission-American immass arose from the teachings of the jesuit mission-aries in Canada early in the seventeenth century. This and analogous names for a Supreme Deity, unknown previously to native belief, have since spread over North America, amalga mating with native doctrines and ceremonial rites into highly

interesting but perplexing combinations. The mistaken attribu-tion to barbaric races of theological beliefs really belonging to the cultured world, as well as the development among races of new religious formations under cultured influence, are due to several causes, which it is the object of this paper to examine (1) direct adoption from foreign teachers. (2) the exaggeration of genuine native deities of a lower order into a exaggeration of genuine native deities of a lower order into a god or devil. (3) the conversion of native words, denoting a whole class of minor spiritual beings, such as ghosts or demons, into individual nanes, alleged to he those of a Supreme Good Detty or a rival Evil Detty

H. Ling Roth read a paper on convoide, in which he gave an account of the distribution of this curious custom, and showed

that the savage believes that there is some hidden link which binds the new-born child to its father, and he argued that the practice of contrade is to prevent the father hewitching his child. In a paper by Mr. S E Peal, on the moreng and other In a paper by Mr. S E Peal, on the morong and other customs of the natives of Asam, the author shows that this institution of the morone, or club-house for the unmarried, is very widely distributed over the whole of the Indo Pacific region, and he argues that it is, in fact, a relic of pre marriage communism Moreover, this quatom being so often found associated with others of a distinctly non-Aryan character, such as juming, lat-tooing, blackening the teeth, building on piles, head-hunting, &c, has led him to suspect former racial affinity, even among such widely different types as Papuan and Mongol. Diavidian and Sawatori

A paper by the Rev B Danks, on the aurual customs of New Britain, was read

In a paper on the worship of metcorites, Prof H. A. Newton, on Monday, gave a series of accounts of divine honours having been paid to meteoric stones in early times, and of myths and oeen paid to meteoric stones in early times, and or myths and traditions pointing to such worship. Particular attention was directed to the indications of such worship that are found in Greek and Roman history and literature

Greek, and Roman history and hierature

1) Grann read a paper on some human remnin found in
horistine. He dealt principally with a round barrow in which
horistine. He dealt principally with a round barrow in which
were much longer and narrower than the heads of the existing
inhabitants of this country, and corresponded with those of the
horistin The awarge height of the persons whose skeletons. Iberans The average neight of the persons wrose sections were found in this barrow was a little over 5 feet 3 inches The discovery of flint and the absence of iron implements showed that the burial took place before the use of metal-The Iberann people were short, had dark hair, straight nose, that forbeads, and no ear lobes 11 was a rate quite distinct from further westwards into forests and swamps

further westwards into forests and swamps. A paperby Mis Backhand was rade, on points of contact between Apperby Mis Backhand was read, on points of contact between Missing and Calant. The substorders was stated from the Missing Chain. The substorders wittenion to the numerous points in which this myth reproduces customs and beliefe of the Dill Worlf. Atmost these were mentioned the singular prohibition of the Missing Calanta and the Missing Calanta and the Missing Calanta and the Missing Calanta and Missing Calanta from the Calanta for the Greek of the Missing Calanta and Missing Declared points out the great contrast between the bloodless Navajo rites and the sanguinary trast between the biocoles's Navijo rites and the sangulary ceremonics of the ancient Mexicans, and the great dissimilarly in the forms of the Navijo and Mexican gods, as denoting an entirely different origin for the two religious, incompatible with the belief commonly entertained of the wholly indigenous dra-racter of American culture, and she unges that the Navijo rites

racter of American culture, and he urges that the Navayn riteporal unmittakely to an Estern or Golomaly, on Essay Central
A paper by the Rev. Jame. Mealound, in Essay Central
A paper by the Rev. Jame. Mealound, in Essay Central
A paper by the Rev. Jame. Mealound is the Mealound
A paper when the Committee of t

criminals.

Dr. S A. K Strahan read a paper on instinctive criminality, its true character and rational treatment. The instinctive

criminal belongs to a decaying race, and is only met with in families whose other members show signs of degradation, in fact, instinctive criminality is the rose of the many hown signs fact, instinctive criminality is the rose of the many hown signs in the result of t Alcoholiam is the most fruiful source of metinetive criminality, but insantly, epilepsy, and suicide are often transmitted to crime in passing to the children Senility and immaturity of parents are also fruiful sources of crime in the enfeebled descendants, as in proved by the statistics of Marro, Korosi, and others. The present system of treatment has proved a disastrous failure, short periods of punishment can have no effect upon the instinctive criminal, either curative or deterrent. Everything missinctive criminal, either curative or deterrelia. Everything points in the direction of prolonged or indefinite confinement in industrial penitentiaries. This system has been tried with success in America, and life-long detention has not been found.

Auccess in America, and ite-iong detention has not neen found by any means necessary. Nicobar pottery, by E. H. Man. In this paper Mr. Man stated that the little island of Chowra has held for generations a monopoly of the manufacture, and the entire work of preparing the clay, as well as of moulding and fing the finished utensi, devolves on the females of the community. The inhabitants of the island appear to guard their art jealously, and the value of trade-marks is recognized. No vessels are made especially by

trade-marks is recognized. No vessels are made especially by the Nicobares for funeral purposes, but cooking polar as among the personal and household requisites which are laid on a manual production of the property of the production of the produ Indian Committee.

SCIENTIFIC SERIALS.

This American Mittorological Journal for Spitember con-tains the concluding part of an article on mountain meteorology, by A L Rotch. The subjects specially treated of are wind and temperature in connection with aimospheric pressure, as observed such part in Bise Itili Observatory. The wind velocity in found other part the Bise Itili Observatory. The wind velocity in found to the part of the lower, but the difference changes for various horizontal part of the busic base and force pomeration increases from the early lower, but the difference changes for various hours of the day, At. took levels the walf force generally increase, from the early morning until the afternoon, but the conditions are reversed at in 1555, when studying the Mount Washington of terminan in 1555, when studying the Mount Washington of the annual the same fact has since been observed at Ben Newfa and the same fact has since been observed at Ben Newfa and horizontal motion, which has amounted to seven miles an hour the same fact has since the world of the same fact has since been observed at Ben Newfa and horizontal motion, which has amounted to seven miles an hour than the same fact has since the same fact has since the same fact has some the same fact has a some than the same fact has some fact has s horizontal motion, which has amounted to seven miles an hour in a storm. The formula temperature at the summar of Blue and the state of the state of

SOCIETIES AND ACADEMIES

Academy of Sciences, September 14.-M. Duchartre in the Academy of Seiencea, September 14.—M. Ducharte in the chair.—Recent discussions on the subject of cyclones, by M. If Faye — A contribution to the botanical history of the truffle—Kammi, from Damas (Terfens (Zhanzy), by M. A. Chatin, A description of a new species of truffle—the whate truffle of the desert, known in Syra under the name Kammi. It has a wide range, the same species as thu found near Damas having been range, the same species as this found near Damas having been also seen in the desert ato miles south of Bishrs. It forms an important atticle of food —On the incandesence of platinum writer under water, by M. Faquelin. A mixture of hydrocarbon respons and air sile dover a specially arranged platinum will then remain luminous if waddenly planned into series.—Observation, by will then remain luminous if waddenly planned into series.—Observation, by M. G. Le Cadet.—On the yeast of wine, by M. A. Rommier Experiments and the series of the same ments made on the production of yours from wine of the same ments made on the production of yours from when of the same ments made on the production of yours from when of the same stock grown in different districts lead to the conclusion that the suces grown in unretent districts lead to the conclusion that the ferments producing the characteristic bouquet in wines of different districts, are peculiar to those districts and are not carried to new districts readily by the transplantation of the vines.—On the determinism of sexuality in Hydatina tends, by M Maupas

:		
;	CONTENTS.	PAGE
	Physical Units and Constants. By Prof. Joh Perry, P.R S	
ı	Oveters	. 489
:	The Destruction of Mosquitoes, By A E S	. 490
: 1	Our Book Shelf	491
1	King "Materials for a Flora of the Malaya Peninsula"—W B. H.	
	"Toological Wall Pictures," and "Animals of the World, arranged according to their Geographical	492 I
1	Distribution"	40.0
	"Crozet's Voyage to Tasmania, New Zealand, the Ladrone Islands, and the Philippines, in the Year 1771-72"	s
1	Johnston "Livingstone and the Exploration of	492
i	Johnston 'Livingstone and the Exploration o	
ı	Letters to the Editor:-	492
1	The National Home-Reading Union.—Dr Alex.	
1	The second secon	493
l	Notorycles typhlops Prof Alfred Newton, F. R. S. "W = Mg." - W. Larden, A. G. G ; Tommy	493
1		493
1	Sleep Movements in Plants A. G. Tansley .	494
ļ	An Oviparous Species of Peripatus - Prof. A. Sedg- wick, F R S	494
ŀ	A Rare PhenomenonDr Ralph Copeland; W. E. Wilson	
1	Some Notes on the Frankfort International Elec-	494
į.	trieal Exhibition I	494
:	Some Points In the Physics of Golf. II. By Prof P. G. Tait	497
٠.	Hooker'a "Icones Plantarum".	498
	On Van der Waals's Treatment of Laplace's	7,7-
	Pressure in the Virial Rougeton . A Tattan to	
١.		490
	Notes	534
1	Our Astronomical Column:-	334
	Lightning Spectra	504
١.	A New Asteroid	504
	The International Geological Congress: Washing-	, ,
		504
	The Society of Friends of Astronomy and Cosmie	. ,
		507
	The Protective Device of an Annelid. (Illustrated)	- /
		507
1	Beography at the British Association	508
4	Mechanics at the British Association	500

Anthropology at the British Association Scientific Scrials

THURSDAY, OCTOBER 1, 1801.

THE BACTERIOLOGICAL EXAMINATION OF

Manuel Pratique d'Analyse Bactériologique des Eaux.
Par le Dr Miquel. (Paris. Gauthier-Villars et Fils, 1891.)

THERE is probably no body of scientific men amongst whom national feeling and prejudice are so little under control as the workers in the domain of bacterology. In perusing memoirs, text-books, dictionary-articles, and literature of every kind bearing upon this infant science, the reader must almost invariably take into consideration the language in which they are written, more especially whether German or French, and if the author belongs to nether of these rival nationalities, it is not unfrequently desirable to ascertain in which of the two camps he has been educated, for, unless this be made allowance for, a warped and often erroneous impression will be carried away.

The present work certainly forms no exception to this state of things; indeed, this phenomenon of party-spirit is regretably prominent. Thus, in reading one of the first paragraphs, beginning with "Les premières statistiques relatives à la richesse bactérisente des eaux furent publiées par moi," and, indeed, throughout these pages we are reminded of the words of the deeply lamented savount who commenced his monumental work with "La chimie est une science française," and perhaps even more of the famous utterance, "L'étai, c'est moi?"

Dr Miquel's treatise, consisting of 194 pages, is divided into five chapters, dealing respectively with (1) the collection of samples, (2) the transport of the collected water, (3) the quantitative analysis, (4) the qualitative analysis, (5) the interpretation of the results obtained. On these subjects Dr. Miquel should be well qualified to write, because, as be informs us, it is only in his laboratory at Montsouris that the bacteriological examination of water has been carried on over a period of eleven years. Indeed, we know of no bacteriologist who has so entirely devoted his attention to the subject of micro-organisms in air and water as Dr Miquel, whose name is so inseparably connected with "les organismes vivants de l'atmosphère." His energies have, however, apparently not been so successfully directed to the aquatic as to the aerial microbes, for we do not connect Dr Miquel's name with any of the more important advances that have been made in our knowledge of the bacteria in water during the past ten years. The comparative sterility of Dr Miquel's researches in this direction is perhaps partially to be accounted for through the extraordinarily cumbrous method of water-examination which he formerly exclusively employed, and which has placed him at a great disadvantage by the side of those investigators who at once availed themselves of Koch's methods, which Dr. Miquel, like many other French bacteriologists, has only adopted with reluctance, or almost under compulsion. The chief interest attaching to the bacteriological examination of water lies in its application to the hygiene of water-supply, inasmuch as it is all but certain that two at least of the most fatal zymotic diseases-cholera and

typhoid-can be, and are, constantly propagated through the presence of specific micro-organisms in water, and indeed the majority of bacteriologists are agreed as to the particular forms responsible for these diseases. On this account it is conceived by many that the primary object of the bacteriological examination should be the search for such pathogenic microbes. This view is apparently endorsed by Dr. Miquel when he says, "Le but que doit poursuivre le micrographe dans les analyses bactériologiques de l'eau est sans contredit la découverte des organismes pathogènes", although the logical conclusion to be drawn from the pages which follow, and in which he details the methods to be pursued in this quest, is that such an investigation is generally fraught with insuperable difficulties, and, for sanitary purposes, practically worthless Thus, without wishing to detract from the importance of the discovery by Chantemesse, Widal, and others of the typhoid bacillus in certain waters which had been suspected of propagating this disease amongst their consumers, it is surely obvious that, even if this organism could be detected with unerring certainty in any water in which it was present, a search for this bacillus in the ordinary course of water examination would still have only a very subsidiary interest. Waters are surely not only to be condemned for drinking-purposes when they contain the germs of zymotic disease at the time of analysis, but in all cases when they are subject to contaminations which may at any time contain such germs. Sewage-contaminated waters must on this account be invariably proscribed, quite irrespectively of whether the sewage is, at the time that the water is submitted to examination, derived from healthy or from diseased persons. In the present state of our knowledge there can be no doubt that chemical analysis affords us in general a better, although a far from perfect, indication of sewage contamination than do the results of bac-teriological examination. The real value of these bacteriological investigations, if judiciously applied, consists in their power of furnishing us with information as to the probable fate of dangerous organisms, should they gain access to drinking-water. It is by their means that we have learnt that many such organisms can preserve their vitality, nay, in some cases can actually undergo multiplication, in ordinary drinking-water, that they are destroyed by maintaining the water at the boiling-point for a short time; and that they are more or less perfectly removed by some processes of filtration and precipitation. whilst other processes of the same nature are worthless, or even worse

These Inapprant results are of the greater value manusch as they have been obtained not only by experimenting with the few pathogenic organisms with which we are at present acquainted, but by studying the effect of there several processes on the complex mixtures of micro-of-gramms is that are to be found in natural waters. The rapidity with which this knowledge has been acquired is due to the quantitative accuracy combined with facility of manipulation which characterize the method of gatinne-plate clitture. It has been repeatedly urged against this method that it is incapable of revealing many well-known forms of bacterns which either do not grow in the gelatine-pletone medium at all, or at any rate not at those temperatures at which it still remains solid, and it

514

is in this respect that Dr. Miguel claims superiority for his infinitely more laborious method of "ensemencements fractionnés " in bouillon It is obvious that labour must be no consideration if any great scientific advantage is to be attained, but, on the other hand, the unnecessary complication of processes, without corresponding benefits. must invariably lead to the retardation of scientific progress Now, it would certainly appear that the benefits obtained by Miguel's process are in no way commensurate with the additional labour which it entails. Thus, his process is also incapable of revealing all the microbes which may be present in water, and yields at best only a closer approximation to the total number than does the gelatine method. For the general purposes of the bacteriological examination of water, however, it is of very little consequence whether the method employed reveals, say, 30, 50, 70, or 50 per cent of the total number of microhes present, all that is required being a result which will serve for comparison. Thus, supposing it is desired to ascertain the efficiency of some process of filtration, provided that the unfiltered and filtered waters respectively are submitted to the same method of examination, the comparative result will be the same whether 50 per cent only or all the microbes present are in both cases enumerated. Thus putting this statement to the test of actual experiment, from the results of the gelatine-plate method of examination I reported to the Local Government Board in 1886 that the average reduction in the number of micro-organisms present in Thames water effected by the sand-filtration of the several London water companies amounted to-

```
98 6 per cent for the Chelsea Company,
                        West Middlesex Company.
                       Southwark Company,
Grand Iunction Company,
96 2
                       Lambeth Company,
```

whilst Dr Miquel in 1890 gives as the effect of sandfiltration on the water of the River Loire a reduction of 99 3 per cent. in one case, and 99 4 per cent in another case A concordance more complete than this can certainly not be demanded Similarly it can be shown that Dr Miquel's method of water examination has not yielded any results of importance which had not already been arrived at before by other investigators using the more expeditious method of plate cultivation. It is indeed only for such differential experiments as that referred to above that the bacteriological examination of water, in the present state of our knowledge, is really of much value, for any judgment as to the purity or otherwise of a sample of water based upon the actual number of microbes found in a given volume of it, is liable to lead to the most serious errors, in consequence of the remarkable power which some bacteria possess of multiplying to an extraordinary extent in waters of the greatest organic purity, in fact, it is precisely in the purest waters that such multiplication is often most pronounced. It is the possibility of such multiplication taking place which renders it imperative that samples of water should be submitted to bacteriological examination within a few hours of their collection In order to overcome this difficulty, which has hitherto debarred the examination of waters from distant sources, Dr Miquel has the samples transmitted in a box surrounded with ice; to this there are manifold objections,

for the low temperature thus secured by no means completely arrests the multiplication of some bacteria, whilst it causes the destruction of others. Dr George Frank, of Berlin, on the other hand, seeks to overcome the difficulty by deputing to persons on the spot the task not only of collecting the samples, but also of preparing the plate-cultures, but, considering the nature of the instructions which he finds it necessary to give to the novices to whom this work may fall, the expedient does not appear very promising The following is a verbatim extract from these instructions recently published in a German scientific journal of repute, which surely demands no comment :--

"The person commissioned with the collection of the sample takes off his coat, turns up his shirt-sleeves on both arms, fastening them so securely that they cannot fall down of themselves I hen he washes his hands and arms most carefully with soap and brush to above the elbow-joint Special care must be bestowed upon the cleansing of the finger-nails, which must if necessary be treated with the nail-file. Finally, the person in question dries himself with a clean towel."

We take it that the value of results depending upon manipulations carried out by persons requiring these instructions would be such that it would be no loss if they were dispensed with altogether Indeed, unless the bacteriological examination of water be invariably carried out by qualified persons, and by them employed only in cases where it is really capable of rendering service, it is certain to fall into that disrepute which has so frequently been drawn down upon the chemical examination of water through incompetent analysts. Indeed the bacteriological method has already seriously suffered in public estimation through the contradictions which have resulted from the attempts made in some quarters to classify waters according to the number of microbes revealed on cultivation. Such arbitrary standards have already done much mischief in the case of the chemical analysis of water, in the bacteriological examination they are still more reprehensible, and it is deeply to be regretted that Dr Miquel, in this most recent work on the subject, should seek to perpetuate a system of standards which experience shows to be quite untenable

The work concludes with some excellent recommendations as to the sterilization of water for drinking-purposes, a subject which cannot be too frequently brought into public notice, for, using Dr Miquel's own words, "la vie d'un homine a bien sa valeur à côté du prix insignifiant auquel revient le litre d'eau purgée de germes qu'il peut consommer en vingt-quatre heures "

PERCY F FRANKLAND

EPIDEMIC INFLUENZA

Epidemic Influenza · Notes on its Origin and Method of Spread By Richard Sisley, M.D (London: Longmans, Green, and Co., 1891)

THE object of this brief treatise, which was prepared before the issue of the Report of the Local Government Board, is to prove the doctrine, widely held by physicians of eminence in the eighteenth century, that influenza is contagious, or, more strictly speaking, infectious, and therefore, in the opinion of the author, fit to be included among the diseases of which notification is locally compulsory. The book is somewhat peculiar in its arrangement, but in the essential qualities of impartiality and clearness leaves nothing to be desired Many readers who do not require more than specimens of evidence, will thank Dr Sisley for compressing the digest of "many thousands" of notes into such narrow compass, but other minds will require a chain of which every link is massive, to guide them to the point of view whence practical conclusions are palpable. If the manner of statement is somewhat bare, and examples rather scanty, in the exposition of a strong but disputed case, the facts brought forward bear none the less value in their neutral setting, and go far to justify the proposition with which he confronts us at the outset, derived from a study of the distribution of the disease and from its pathological character Valuable assistance from Dr. Klein. Prof Fleming, and many others, has enabled him to include in his pages some interesting matter relating to the microbic nature of the epidemic and its relation to a similar disease in animals. After all that has been conjectured on the latter point, it appears that evidence of any unusual prevalence of influenza among animals at the time is still wanting

The original seat of influenta, which has been obscurely indicated in previous times as lying somewhere "in the East," has now been discerned in Mongolian and Chinese territory, for we have two independent accounts, each speaking of influents as not uncommon in some parts of China. In Mongolia "its seldom proves, fittal, but travellers are careful to avoid it, and no one would think of using the pot or ladle of a family suffering from this sickness". If the disease is sporadic and endemic in these countries, the population may be to some degree protected against epidemic outbreaks, for some degree protected against epidemic outbreaks, for much less marked in one to the indicate of the production one year, and least, on the whole, in those places where it was previously most severe.

The notes from Bokhara, translated in this volume, are of great importance, for they show how a wet spring had turned the neighbouring country into a perfect marsh, from which, when the hot weather set in, poisonous exhalations were given forth, and how the people, crowded together with horses, cattle, and sheep between high walls, distressed and weak with starvation and disease, were attacked much earlier than usual, in the first heat of summer, with malaria, and how this was quickly followed by an epidemic of influenza, reaching its height in July 1889. The extension of the disease westwards from Bokhara by the flight of convalescents to Russia, and eastwards by caravans to post-stations in Siberia, has been noticed in the official Report, and completes the evidence connecting the European epidemic with the miserable condition of an Asiatic town Upon such a soil, influenza sprang into fatal activity, and acquired, as we may fairly infer, a particular virulence In similar conditions, amid the filth, floods, and famines of Asiatic countries, cholera and other plagues of men and animals have been evolved and have set forth on their destructive march

By reports from several medical officers, and by a number of charts showing the curve of prevalence of the

disease in English and foreign cities, Dr Sisley shows that we have no experience of any sudden prostration of a large population within a few days, such as was formerly supposed to occur, but that the rise is always gradual from a few cases to hundreds and thousands, the maximum usually occurring from one to two months after the first cases in the locality have been noted. Last century Dr Havgarth had been fortunate in discovering the person who brought the infection to each place in his district. If equal pains had been taken in 1800, when the disease was on its way to us from Russia, the persons who conveyed it from country to country might, no doubt, have been identified. The author has not been able to find a single instance in which there was a sudden infection of a large number of people without the previous existence of cases of the disease, and wherever its course was studied with care, it was seen to spread in the same way as other infectious diseases "atmospheric" doctrine, though previously disproved with regard to rabies, cholera, and pestilence in general, still finds a stronghold in consumption and influenza.

The classic examples of ships supposed to have been attacked on the ocean by wind-borne influence, as well as those of towns supposed to have been pro-trated "in a single day," really bear testimony to the insidious growth of the disease and to the necessity of early recognition. Neither in this volume nor in others on the sample day the disease and to the necessity of early recognition. Neither in this volume nor in others on the supposition of the same of the growth of the growth of the day of the d

The total evemption of lighthouse-keepers, deep-sea shehreme, and univisited shands, is scarcely noticed by Dr visley, but he considers the rarity of influenta among prisoners to have been due to their removal from sources of contagion, and relates a very interesting case of contagion, and relates a very interesting case of contagion, and relates a very interesting case of experient infection of a man on his way home from a light-ship through contact with the crew of a fishing-boat, said to be in good health

Dr Sisley concludes that there is no convincing proof of transmission through unaffected persons, letters, &c : but a series of cases each of considerable weight surely amounts to evidence strong enough to justify some precautions, such as would be taken with the organic dust from more serious diseases, eg scarlet fever and diphtheria, which are so transmissible is happily a great deal in common in the mode of spread of most symotic diseases, and disinfection as usually practised could hardly be misapplied to influenza The same may be said with regard to isolation, for no attack, however trivial in itself, is a maiter of indifference to the public, if it may result in widespread illness, loss of work, and distress. A short retirement is desirable in the interest both of the patient and of the public But Dr Sisley can hardly desire that notification should take place on exactly the same lines as that of other diseases, for local authorities would with reason wince at the expense, and unless the notification were a national undertaking, no district would be adequately protected thereby from imported cases. Complete and national measures of notification and isolation, with the co-operation of local authorities, would be much more likely to be effectual. An expenditure of one-fiftieth of the cost of the recent epidemic would probably secure the country from any such infliction in future. But we must admit that without a somewhat strict supervision at ports of entry during the period of prevalence in other countries, and without provision for the segregation of slight or suspected cases during that period, mere notification would not be likely to put a stop to the spread of influenza The early cases are worth taking a great deal of trouble to discover and isolate When once many cases have occurred in a locality, the further progress of so protean a disease is difficult to The best chance of averting an epidemic must be sought in scrupulous care for early isolation, in tracing the movements of travellers from infected towns. and in the increased practice of ventilation in private houses and in public gatherings Like typhus, influenza seems incapable of inflicting much damage except through the medium of close, confined, and impure air, and where measures of isolation and disinfection are used it seldom spreads. But the infectious character of influenza must be internationally recognized before protective regulations can achieve a full measure of success, R RUSSELL

GENERAL CHEMICAL MINERALOGY.

Allgemeine Chemische Mineralogie Von Dr. C. Doelter, O. Professor der Mineralogie an der K K Universität Graz. With 14 Figures in the Text (Leiping: W. Engelmann, 1890)

M INERALOGY, at first purely descriptive, has been raised to the dignity of an experimental scence by the application of the principles of chemistry and physics. The writer of a mineralogical text-book is thus met at the outset with the difficulty of deciding what amount of knowledge of chemistry and physics to assume in his reader. With regard to the chemical sole assume in his reader with regard to the chemical sole assume that he knows verified, and yet, somewhat inconsistently, to make the exposition of the atomic theory and the fundamental principles of chemistry so brief as to be of little service to one who has had no previous acquaintance with the subject

The author of the present, in many respects useful and suggestive, book follows the same lines. The whole account of the findiamental chemical theories occupies about ten pages of the introduction. The same fault will be found in other parts of the book. e.g. it would be difficult to say to what class of reader a large portion of the chapter on chemical analysis would be useful. In his endeavour to introduce as many extracts as possible from the current literature of the subject, the author allows himself in many places to become somewhat selectly. In spite of this, the book, with its wealth of information upon points which have not hitherto found a place in ordinary mineralogical text-books, will be found to give a very good idea of the present state of mineralogical selectnost, will be found to give a very good idea of the present state of mineralogical selectnost or view.

The arrangement of the book is in seven sections, viz (1) introduction; (2) chemical crystallography; (3) chemical analysis of minerals; (4) synthesis of minerals; (5) metamorphism of minerals; (6) formation of minerals

NO. 1144, VOL. 44]

in nature; (7) chemical composition and constitution of minerals

In the introduction, containing an account of the atomic theory and its consequences, one or two suggestive ideas will be found . e.g. the correspondence, pointed out by Tschermak, between the chemical law of multiple proportions and the crystallographic law of simple parameter ratios: and also the analogy between the law of constant proportion by weight and the fundamental crystallographic law of constancy of angle. The subject of chemical crystallography receives very full treatment, Here the reader is initiated into the mysteries of chemical and physical isomerism, polymorphism, enantiotropy, isomorphism, isodimorphism, isogonism, morphotropy, &c : and if the perusal of this section, as well as of the last, on the constitution of minerals, shall leave him with a rather confused and unfavourable idea of the subject, the fault should perhaps he rather attributed to the present imperfect state of our knowledge than to the author At present it is in most cases impossible to say whether bodies are polymeric, metameric, or chemical isomers

As regards isomorphism, if the formation of mixed crystals is to remain the test, the original definition of Mitscherlich must be modified to suit the fact of the formation of mixed crystals from compounds of not precisely analogous chemical composition. Thus, according to modern views, isomorphism is in some degree to be deposed from its proud position as an infallible guide to chemical composition. The insidious nature of the attack upon this ancient stronghold of the faith may be judged by a comparison of one of the latest definitions of isomorphism with the original definition of Mitscherlich. According to the latter, isomorphism is the power which two or more compounds of analogous chemical composition possess of crystallizing in the same or similar crystalline forms, and of mixing in varying proportions to form homogeneous crystals. The latest definition is that bodies are isomorphous which, with for the most part similar chemical composition, possess the property of crystallizing in similar crystalline forms, and of forming mixed crystals which morphologically and physically graduate into each other. Such a change it is expected would lead to a considerable simplification in many of the formulæ which have been made unnecessarily complicated in order to comply with the requirements of Mitscherlich's definition

The section on chemical analysis of minerals is one of the least statisfactory in the book. Short summaries of analytical methods can be of little service to any class of reader. Amongst matter which will not be generally found in the ordinary chemical test-book, this section contains some account of microchemical reactions, of the methods for the mechanical separation of minerals, so as on the contract of the course of analysis and directions for the course of analysis to be pursued in the case of the more important minerals.

The important subject of mineral synthesis receives more complete treatment than any other in the book. The section contains general accounts of the various methods for the artificial production of minerals by chemical reactions, fusion, sublimation, electrolysis, diffusion, &c., with detailed descriptions of the apparatus required.

The sections on the metamorphism of minerals, and on the formation of minerals in nature, will be found of great interest to the petrologist. Here are described the effects on minerals of heat, of gases at high temperatures, of fusion, of fused maginas, of water containing carbonic acid. &c. In the last section, dealing with the composition and constitution of minerals, the present imperfect state of our knowledge is brought prominently to light The battle is still being fought between the so-called chemical, liquid, and crystal molecule; between constitutional and empirical formulæ Mineralogists are beginning to understand that it is impracticable to attempt to use for complicated minerals principles which are only applicable to volatile organic compounds, and the idea is gaining ground that many minerals are molecular compounds only capable of existing in the solid state, the crystal molecule being built up of different chemical molecules

The author intends to supplement the present work by another, entitled "Chemical Mineralogy," in which the composition, synthesis, &c, of each individual mineral will be treated more particularly. The present volume is intended as quite a general treatuse on the subject of mineral chemistry, in fact, we cannot help thinking that in many parts the treatment is far too general, and that the book has been partially sacrificed for the sake of the volume that is to follow. The value of the book is increased by the lists of references to the literature which precede each section.

OUR BOOK SHELF.

Bush Friends in Tasmania: Native Flowers, Frints, and Insectit, drawn from Nature, with Prose Descriptions and Illustrations in Verse By Louisa A Merchith Executed by Vinent Brooks, Day, and Son. (London and New York Macmillan and Co., 1891)

UPWARDS of thirty years ago Mrs Meredith gave the world a volume containing admirable coloured figures of world a volume containing adminable coolered lightes and a selection from the many beautiful plants and insects that inhabit her island home, Tasmania, and now, in the evening of a long life, she has travelled to the old country to publish a second volume, which is to be the last Her purpose achieved, she "hopes to return and end her days among her children in that pleasant colony," which has given a brighter home to so many of our kith and kin Lovers of the beauties of Nature in this country will find much pleasure and instruction in this second volume from that talented lady's pen and pencil, and will be able thereby to form some conception of the totally different kind of vegetation from our own that clothes this remote southern island, as well as the great Australian country, for it is only a part of the same flora. To the colonists themselves the book will be even more attractive, as a means of becoming acquainted with the names and affinities of the beautiful objects with which they are surrounded. It will also, it is to be hoped, teach them to prize and preserve these rare and precious gifts Like all true lovers of Nature, Mrs Meredith deplores the wanton destruction of rare flowers near Hobart by thoughtless or greedy persons whose only aim seems to be quantity.

The botanical part of Mrs. Meredith's book is per-

The botanical part of Mrs. Meredith's book is perfectly trustworthy, having been scrutinized by so eminent an authority as Sir Joseph Hooker; and Prof. Westwood furnished the names of the insects.

Some of the poems have a special interest in connection with the early history of the settlement of Tasmania

Notably an "Old Story" of 1834, which narrates the massacre by aborigines of a whole family—father, mother, and seven children.

The Elementary Geometry of Conics, with a Chapter on the Line Infinity Bs C Taylor, D D. (Cambridge Deighton, Bell, and Co., 1891)

DR TAYLOR'S "Geometry of Contas" is so well known, and has met with such acceptance—this is the seventh edition, revised—that we are not called upon to give a bref notice. A new chapter ((u)) contains "a course for the contains a part of the contains a course for the contains a part of the contains a course for the contains a part of the cont

order to draw the asymptotes before tracing the curve, for the hyperbola seems to have been discovered from its "equation" (A I G T Report, 1800, p. 12). It is somewhat remarkable that Dr Taylor does not give a proof of this equation. We append one. Taking his figure on p. 103, we draw the second adymptote Now draw PM parallel to C/p, cutting the axis in K, and the second asymptote in M then.

4CM MP = 4MK . MP = (MP + MK)² - (MP - MK)³
=
$$C\rho^2 - KP^2 + \lambda^2(\rho N^2 - PN^2)$$
 (where λ is a constant)
= $\lambda^2(S\rho^2 - SP^2)$
= $\lambda^2(S\rho^2 - \rho^2) = \lambda^2 - SY^2 - C\alpha^2 + \alpha^2 + \delta^2$

Again, let PQ be any chord meeting the asymptotes in p, q, and let Ql, Pm, parallel to Cp, Cq respectively, meet those lines in l. m. Then we have

$$\frac{Pq}{Cm} = \frac{Pp}{pm} = \frac{pq}{Cp} = \frac{Qq}{Ql},$$

$$\frac{Pq}{Qq} - \frac{Cm}{Ql} = \frac{Cl}{Pm} = \frac{pQ}{Pp},$$

hence Qq

$$Qq = Qa$$
, and $Pa = \phi Q$.

Other properties occur to us, but the above are classic properties of the curve, and the wonder is that Dr. Taylor has not applied his new treatment to obtain them. There is no suggestion that they can be so obtained, either in the book or the original paper as printed in the A I G.T. Report.

Les Engrais Chimiques Par Georges Ville. Septième Édition. (Paris: M. Engel, 1890.)

THIS is a new edition of the author's lectures on chemical manures, which were first published in 1868, and which have been translated into seven languages. An English edition, by Mr. Crookes, was published in 1879. The sixth French edition has been out of print for about ten years, and during that time the price of chemical manures has considerably declined, on an average about 40 per control of the control

crops Thus, potassium chloride replaces potassium nitrate in the manure for leguminous plants, and in some cases a mixture of potassium chloride and ammonium sulphate replaces potassium nitrate, and a few other alterations are suggested in the treatment of various crops Thomas's basic cinder is not mentioned as a source of phosphoric acid The lectures themselves, and some controversial matter, are reprinted in their original form, and but little new matter is added

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Nisther can he undertake to return, or to correspond with the worters of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications!

The Bird-Collections in the Oxford University Museum

DURING a recent visit to Oxford I took the opportunity of examining the collection of birds in the University Museum, and her leave to offer a few remarks upon its condition

First, as regards the mounted specimens, there are three series belonging to this category -
(1) The general series in the Central Court. This numbers

(1) The general series in the Central Court. This numbers about 1100 speedment, which are contained in twelve cases, placed in opposite rows of six each, but rather mixed up with a ranged according to Cap's etc., but rather mixed up with containing to a content of the containing to the containing to a containing to a containing to a containing the containing th The whole series requires renovation and rearrangement, ac-cording to some modern system, and the orders and families should be designated by labels, and distinctly separated one from another

from another

(2) The collection of Arctic birds formed by Mr. J. Barrow, F.R.S, and presented to the Museum by that gentleman. This meresting collection, which has been well described by Mr. Harting in the /Mr., is placed in the gallery. It is well because the properties of the described to keep it apart from the general series.

(3) The Brutak series, also placed in the gallery, which is in fair order, shlooph it also requires revision and rearrangement according to some modern system. It ought not to be difficult to find some member of the Britah Dentihologists. Union to

undertake this task, provided that the authorities will allow him

Besides the mounted specimens, there are, as I understand, about 4000 skins of birds, most of which are "put away" in boxes in various parts of the building. Of these, the only portion boxes in various parts of the faulding. Of these, the only portion that I was able to see was the Bornean collection formed by Mr. Everett, and pastly described by Dr. Bowdler Sharpe in the Zoological Society's Proceedings. These are placed in some drawers in the main hall. The other skins are stated to be "Doced up," and are kept patily in a room on the ground floor, and parily in some "upper chamber," to which no ready access is possible.

I venture to suggest that one of the side rooms in the Museum should be cleared of its contents, and devoted entirely to the bird skins, and that they should be arranged there in calinets, so as to be accessible to the ormithologist. It is hardly right for a great and rich University to accept collections from persons who, in the words of the late Prince Bonaparte put forward on a similar occasion, "croyant qu'ils travaillaient pour la science, non pas travaillés que pour les mites "I may add that any assistance that I can give in carrying out this reform will be most gladly rendered P L SCIAFER 3 Hanover Square, London, W., September 4

Variation and Natural Selection

In Prof C Lloyd Morgan's Presidential address to the Bristol Naturalists' Society, on "The Nature and Origin of Variations" (of which he has kindly sent me a reprint from the Society's Proceedings), there are one or two points on which there seems to me to be a slight misconception; and as the difficulties auggested have probably occurred to other naturalists.

NO. 1144, VOL. 44

wish to make a few observations in the hope of throwing a

I wish to make a two observations in the more common little light on this observations that the plan of the variability of species in a state of nature which I have adduced in my "Darwinsin" (to which proofs Prof. ILoyd Morgan has made some important additions in his recent work on "Animal Life and Intelligence") he remarks: "We have been api to suppose that a species is so nicely adjusted to its surrounding conditions that all variations from the type, unless of a very insignificant character, would be rapidly and inevitably weeded out. This, it is clear, is not true at any rate for some species." And a little further on, after discussing the question whether variations in all directions occur in equal proportions-an equality which does not appear to me to be at all necessary, or to have been ever suggested as occurring that the evidence in Mr Wallace's third chapter, while con clusive as to the occurrence of variations, gives on analysis little or no evidence of any selective agency at work "

The difficulties here stated appear to me to depend, chiefly, on not taking account of some important facts in nature fact is, that the struggle for existence is intermittent in character. and only reaches a maximum at considerable intervals, which may be measured by tens of years or by centuries. The average number of the individuals of any species which reach maturity may be able to survive for some years in ordinary seasons or under ordinary attacks of enemies, but when exceptional periods of cold or drought or wet occur, with a corresponding scarcity of cold or drought or wet occur, with a conception, and certain kinds of food, or greater persecution from certain enemies, then a rigid selection comes into play, and all those individuals which vary too far from the mean standard of efficiency are destroyed

Another important consideration is that these epochs of severe struggle will not be all of a like nature, and thus only one parstudge, with not be all of a like fractic, and inde only one par-ticular kind of unbalanced or injurious variation may be eliminated by each of their. Hence it may be that for consider-able periods a most all the individuals that reach maturity may he able to survive, even though they exhibit large variations in many directions from the central type of the species. During such many directions from the central type of the sponce. During such quescent periods, the chief elimination will be among the young and immature. Thus, with birds probably mine tenths of the destruction occurs among the eggs and half fledged young, or among those which have just escaped from parental care, while those which have surved to breeding age only suffer a slight destruction in ordinary years, and this may occur partly among the less experienced, partly auong those which are old and somewhat feeble

somewhat feeble. The severe elimination that occurs in the earlier stages may be thought to be accidental, but I doubt if it is really so except in a very finall degree. The protections and concealment of the eags and young in the nest will depend chiefly on the mental qualities or invinits of the parents, and these will have been qualities or invinits of the parents, and these will have been dependent of the parents and the parents and the parents and the parents are the parents of the parents and the parents are the parents of the parents and the parents are the parents and the parents are the parents and the parents are the parents are the parents and the parents are the par deficiency And with young birds of the first year there will be an equally rigid selection of the incautious, and of those who are deficient in any of the sense-perceptions, or are less strong and active than their fellows.

The proof that there is a selective agency at work is, I think, to be found in the general stability of species during the period to be found in the general stability of species during the period of human observation, notwithstanding the large amount of variability that has been proved to exist. If there were no selection constantly going on, why should it happen that the kind of variations that occur so frequently under domestication. never maintain themselves in a state of nature? Examples of this class are white blackbirds or pigeons, black sheep, and unsymmetrically marked animals generally. These occur not unfrequently, as well as such sports as six-toed or stump-tailed cats, and they all persist and even increase under domestication,

cats, and they all persust and even nucrease under domentication, but never in a state of nature, and these seems no reason for the strength of the strength o tunate objection, since, in constantly recurring circumstances during the life of a savage, this very character must be of vital importance. Whether on the war-path, or in pursuit of game,

or when escaping from a human enemy or from a dangerous animal, the thickness of the sole, its insensibility to pain, and its resistance to wear and tear must have often determined life or death. A man who became sore footed after a long day's or desth. A man who became sore footed after a long day's tramp, or one whose thin tole was easily cut or torn by stones or stumps, could never compete with his thicker soled companions, other things being equal, and it seems to me that it would be difficult to choose a angle physical character whose variations would be more clearly subject to the law of selection. With the greater portion of Prof. Lloyd Morgan's very interesting address I am in perfect accord, and it is because his remarks and suggestions are usually so acute and so well founded

that I have thought it advisable to point out where I think that his objections have a less stable foundation ALFRED R WALLACE

A Rare Phenomenon,

THE rare phenomenon to which your two correspondents refer in their letters in your last issue (p 494) was visible here at pre-cisely the same time, and, viewed from Nottingham Forest, it presented a most interesting sight. It is currons that, as both presented a most interesting sight. It is carnots that, as both the time and duration of the phenomenon connection with its three times and duration of the phenomenon connection with its half more than the present of the present of the phenomenon of a well-defined display of the half more its expression of the phenomenon of a well-defined display of the half more its present of the phenomenon of the pheno character described by your correspondents, but vertical changing rays, several of which were distinctly orange-tinted
Nottingham, September 26.

ARTHUR MARSHALL

YOUR columns record, from Ireland and Scotland, observa-tions of the aurora to which I called attention last week. It was seen also in Warwickshire, the coruscations being so marked hibition Mr E B Knobel informs me that, from S to 10 p m on the 11th, during which time the appearance was visible, active magnetic disturbances were noticed at the Royal Observatory, Greenwich, illustrating the close connection which has been established between auroral and magnetic phenomena.

W Tuckweil

IT may be of interest to your readers to know that the frare phenomenon, nestioned (p. 494) was seen pine from Frare phenomenon, nestioned (p. 494) was the supple of the thought to be a ray proceeding from a search-light), was vanish ear the Pleades, at short 9,30, extending over an arc of about \$25, the with being pinhably about ? I Ingradually field away, and at 10 no trace of it was left P C Levandes.

30 North Villa, Cambon Square, N W, September 28

Instruments in Just Intonation

As you have raised once more the question of justly in-toned instruments, may I ofter the following remarks? It does not seem likely that any arrangement for the organ would be practically adopted unless it permits as much freedom of modu-lation and of execution as that of equal temperament. To lation and of execution as that of equal temperament. To permit perfectly free modulation, with practically perfect intervals, nothing short of the cycle of fity-three will suffice. Now to construct a key-board with fifty three noises to the octave which can be played upon with the facility of a twelve note key-board and the facility of a twelve note key-board. seems impossible But the problem may be approached differently; as it is only necessary to use twelve notes at a time, the keyently; as its only necessary to me twelve notes at a time, the key-board might remain as it it, and rolly a mechanical deviewe would be required to make these twelve keys correspond to the required twice out of high necessary on large organity the mechanical difficulties could easily be overcome. For example, arrange a "duodenarum," and connected electrically to the fifty the trackers; 17. as suggested by Dr., Blitts-as a "duodenarum," and connected electrically to the fifty the trackers; 17. as when trackers would be a support of the connected to the trackers and the support of the connected studs -Bbb, Cbbb, Ast stude to tracker 46 for instance.

NO. 1144, VOL. 44

Opposite these studs would be another set of 117 connected to the twelve keys, e.c. C, B. B. Bat, D250, &c, all to the key C. between the two sets of stalls would be a frame carrying twelve contact pieces, the frame would then be moved along guides by the assistant, so that the twelve keys were electrically connected to the right doudgne of study, and hence could be made to open

the right group of pipe.

Thus the only alteration in printing required would be to mark the duodene on the music. All the extra complication would be thrown on the mechanical arrangements, and the It seems to on anist would be left in the same position as now me that any more complicated key-board would fail in a large organ, through overburdening the organist.

ROBI A LEITFELDT Firth College, Sheffield, September 14

Unusual Frost Phenomenon

"As perhaps you may never have seen this form of ground frost, I append a rough sketch of its very singular appearance



I have only shown three layers , there were five, but this may give you some klea of its appearance—quite a columnar hasaltic

appearance Every morning here after a sharp frost, the whole of the ground, where not covered by grass or rubbish, is raised up thus. On the sides of the cuttings and banks of our claim, these tee fibres may be seen projecting from the walls in bunches of snowy filaments, like spun glass. The sun, however, soon causes them to drop off, and they lie in heaps of some six inches in depth."

A II. WHITL. Richmond, Surrey.

The Destruction of Mosquitoes,

The Destruction of Mosquitoes.

Osi two occusions, when proceeding northwards to Arctic.

Noway, I was much interested in observing the fact that the

plages of mosquitoes, which is no intolerable there, especially

prevails in latitudes beyond the northern range of the swallow;

and opinion arround the northern range of the swallow;

and opinion arround with the control of the swallow;

and opinion arround with a processing the processing of the swallows;

martina, &c. If this view is correct, the protection of these

martina, &c. If this view is correct, the protection of these

microbaldies in Mosquitoes. Such protection is very dif
ferent from the indistrumnate scatimentalism about "fmail

plants" which breaks out peroodically at this vession in the news
papers, and neclades such feathered vermin as the third bullet,

sold of the processing of the processi

A Tortoise inclosed in Ice.

DURING the last winter there was a good deal of correspondence in the columns of NAIUER regarding the revivability of sish and insects that had been frozen hard. A similar phenomenon with regard to the tortoise having recently come under my notice, it may perhaps be interesting to some of your readers

to have it pat on record.

Some friends of mine have one of the small water-tortoises that are occasionally exposed for sale in the City Last winter. this tortoise was inadvertently left in his small pond, the water of which froze completely into one block of ice, inclosing the tortoise. When the thaw came, the creature was found alive tortouse. When the thaw came, the creature was found alway and flourithing. I expectally endeavoured to assertion whether and flourithing. I expectally endeavoured to assertion whether to gream, or whether he had been simply frozen into the tor, in spite of toos examining several of the family. I was unable one of the contract of the family is to the contract of the family in the contract of the family is to the contract of the family in the sum of the contract of the family is to the contract of the family in the sum of the contract of the family is the family in the sum of the family is the family in the fami

7 Fowkes Bulldings, Great Tower Street, E.C., September 25

The Soaring of Birds

I HAVE read with much interest Mr Peal's account of the soaring of vultures, pelicans, adjutants, &c., over the plain of Upper Assam (NATURE, May 21, p.56). Their manner of flight is identical with that of caguills and harriers over the Canterbury Plains in New Zealand, which is about 150 miles long and 45 wide in its widest part. These birds begin to soar at a height of about 200 feet, and rise in slanting spirals to 2000 feet and under. The gulls are much the most numerous, and flocks of under. Ine guils are much the most numerous, and nocks of them may be seen soaring nearly every fine day in suinmer. Sometimes a number assemble, and after going round in circles for a short time, without rising, or rising very little, they come down, the condition of the air being apparently unfavourable for soaring. Whenever I have seen a flock finish an ascent, they all down, the community of the community of

limit of their ascent even for a short time, but reparated, sailing away downward to great distances

The explanation of soaring given by Mr Peal can hardly be true one. Bishop Courtenay has shown its inadequacy by proving that a bird in a uniform horizontal current is in no expect more able to support himself itlain an ealm. Though

proving that a time, in someon necroscial current is a my proving that a property is a support of the control o

without any relative motion of the parts, or so lulfe that it could be of no use in sourcing.

**Interpolation of the parts, the word is a right of the albarons [Narrus, and the parts of the parts of

is at its maximum, to the greatest advantage possible. It seems, therefore, that soaring at great heights cannot be explained on the same principle as the saining flight of the albatross, whose movements are confined to a comparatively than atratum of an exit the sae, in which the velocity of the wide increases rapidly extended to a comparative of the contractive of the c

with the height In Lyttelon Harbour, N.Z., which is surrounded by hills except at the entirance, the guill sear by using the upward current on the slopes, running in spirals in precasely the same motive power in the former kind of high it serident, and perhaps throws high on that of the latter. Standing on a slope of about 20, and about 100 feet above the see, I awa is faced of guills began to ascend over the slope. Being constantly among the happing they are very time, and several cane within 15 feet about 100 feet above the several cane within 15 feet about 100 feet above the several cane within 15 feet about 100 feet above the several cane within 15 feet about 100 feet about 100 feet above the contrast of the several cane within 15 feet about 100 feet about 1 In Lyttelton Harbour, N.Z., which is surrounded by hills of birds over a slope by means of the current flowing up it, and their descent in long inclines at a small angle with the horizontal, show that rapid motion through the air cause a great resistance in opposition to gravitation, which resistance has not yet, I believe, been accounted for quantitatively on mechanical prin-

upwand currents may be caused in two ways, but it would not be possible to gree a direct proof that the currents no analog are strong enough. If, however, birds are seen to sear when one or they are true causes of searing.

Leveryone who has watched the working of a windmail must make the search of the search

same time. This tendency of the lower strata to burst up in separate spots may exait where the instability is much less than that required to cause a tornado, as in the case of a plan strongly heated by the sun, and in the absence of any gyratory motion round the centre of an ascending current, there would be no whirlwand, only a

quiet ascent of air, in a slanting direction if there were any wind. Such ascending currents may be of small area, not much larger than the circles described by birds when soating. It seems possible that the object of describing circles may be to keep within the ascending current, though it is true they somekeep within the ascending current, though it is true they some-times describe circles when the ascending current is up a slope and not limited to a small area. If a plain much heated by the sun border on the sea, ascending currents will soon start a sea-breeze, and the cold air from the sea will soon restore the seability of the atmosphere In summer the sea breeze blows over the Canterbury Plains four or five days a week, beginning between 8 a m and noon. When delayed till near noon, the soil and lower strata of air are much heated, and as the previous nights are cool, the conditions for causing the unstable state are present I long ago remarked that the best time to look out for soaning birds is at the commencement of the year-breeze when it soaring birds is at the commencement of the var-preced when it is late. Soaring is much oftener seen here in summer than in winter, and is, I believe, more common, and the species of soaring birds more numerous, and the birds larger, in hot than in cold climates—that is, in climates where the unstable state of

the atmosphere is oftenest caused by the sun's heat.

Mr. Peal says "That there are no uprushes of air I have fairly good proof in the small tufts of cotton from the Bombyx fairly good proof in the small taffs of cotion from the Biemby-maldsbracom which cross the field of mytelescope whose examinate the Newgy lith at a ten, wenty, or there mides places as the same taken to be supported by the same taken to be supported by the same taken to be supported by the same to the same taken to be supported by the same to show that angle with the horizontal, and of convoletable sare, might be detected by a careful observer from the movements of small deducted by a careful observer from the movements of small are might to the same taken to the same taken to the same taken to the same taken to be supported by the same taken to the same taken to be supported by the same taken taken to be supported by the same taken to be supported by the same taken to be supported by the same taken taken to be supported by the same taken ta

easily escape observation

easily escape observation. It is obvious that upward currents over a plain, caused either by variations in the velocity of the wind or by the unstations between the almost inscribble near the state of the stationshere, must be almost inscribble near the state of th

a stope.

I have often observed gulls with extended motionless wings following a steamer in the same relative position for several minutes. In every case it was clear that they used the current diverted upwards by the hull. Before the upward energy of this current is exhausted, a fast steamer has gone a good many tals current is exhausted, a last steamer has gone a good many yards, so that a bird is supported at some distance satern. Also an upward current of considerable strength would flow off the mizen sail of a ship s ailing near the wind and leaning over Christchurch, N.Z. A C Baints

Rain-making in Florids in the Fifties

THE article on "Rain-making in Texas" (NATURE, p. 473) recalled to my memory a passage of Dr. Th. Reye's book ("Wirbelstume, Tornados, &c.," Hanover, 1872, in which (at p. 12 and following) the author in question translates quotations from J. P. Espy's "Second and Third Report on Meteorology, 1851, auf Belchi des Senates der Union gedrukt" Meteorology, 1931, and necessity are seed that great and all experts 1857. The facts related were observed by the surveying officers George and Alexander Mackay. They (in Florida) had at their disposal great quantities of rushes (saw grass), which they set in flame, and the huge conflagrations were invariably followed by rain September 22.

A Dog Story

This following dog story may interest your rederation of the trial took morning. I are more rederadate the trial took morning at the most morning at the control of the

NO. 1144. VOL. 44

SOME NOTES ON THE FRANKFORT INTERNATIONAL FLECTRICAL EXHIBITION 1

A Page of Modern History

E LECTRIC transmission of power to great distances bids fair in the near future to change the whole commerce of the world, and yet the history of its developcommerce of the world, and yet the history of its develop-ment is all comprised within the last fourteen years. In a long paper read in the early part of 1877 before the Institution of Civil Engineers, "On the Transmission of Power to a Distance," the author, Prof. Henry Robinson (now the engineer to various electrical companies), does not even suggest the possibility of employing electricity for this purpose So that in the discussion Sir William Siemens remarked, "He might also refer to another method of transmitting power to a distance, which did not seem to have occurred to the author, perhaps because

it was of recent date, vir by electric conductors"

A week later, Sir W Siemens, in his Presidential address to the Iron and Steel Institute, throws out the idea of utilizing the power wasted in the Falls of Niagara, and after referring to the use of high-piessure water mains and quick-working steel ropes for transmitting power over one or two miles, he says, "Time will probably reveal to us effectual means of carrying power to great distances, but I cannot refrain from alluding to one which is, in my opinion, worthy of consideration namely, the electrical conductor" And he adds. " copper rod three inches in diameter would be capable of transmitting 1000 horse-power at a distance of, say, thirty miles

I he use of the electric current for the transmission of power over considerable distances was, therefore, fully present in the mind of Sir William Siemens in 1877, but not apparently the employment of the high potential differences which are absolutely necessary to make such a transmission commercially possible For a copper rod of three inches diameter, such as he speaks of, has a cross-section of nearly seven square inches, and could carry some 5000 or 6000 amperes without undue heating Therefore, even when the problem of transmitting 1000 horse-power over thirty miles was in question, he did not contemplate, apparently, using a pressure of more than about 100 volts.

At the commencement of the following year, 1878, in his Presidential address to the Society of Telegraph Engineers, he refers to his previous statement, and adds, Engineers, he refers to his previous statement, and adds, "Experiments have since been made with a view to ascertain the percentage of power that may be utilized at a distance." The result obtained, he says, is that "over apper cent of power expended at the distant place may oper cent of power expended at the distant place may oper cent of some control of the control of the oper cent loss, "This made, in reference to the oper cent loss, "This made, in reference to the oper cent loss, "This transmitted were of great though which the power was transmitted were of great through which the power were transmitted were of great

The length of the conductor employed in the above experiment is not given, but its approximate length, as well as what is understood by "great length," may be gathered from the context; for Sir William goes on to consider the problem "of distributing the power of a steam-engine of, say, 100 horse-power to twenty stations within a circle of a mile diameter", and although the distance to which it is proposed to transmit the power is only one mile, he assumes that the loss is what was found in the above experiment, viz. 60 per cent He further adds, "The size of the conductor necessary to convey the effect produced at each station need not exceed half an inch in external diameter." Clearly, then, as the power proposed to be diameter" Clearly, then, as the power proposed to be transmitted by the half-inch conductor to each station one mile distant was only 5 horse, there was no idea of using

' Continued from p 407

a potential difference in the transmission higher than that maintained between the terminals of a lamp

Two wrong notions misled people in those days-the one, that the maximum efficiency of a perfect electromotor could be only 50 per cent ; the other, quoting the remarks could be only 50 per cent; the other, quoting the remand of 51r W Siemens in the discussion of the paper read by Messrs. Higgs and Brittle at the Institution of Civil Legimenes somewhat later in the same year 1878, "In order to get the best effect out of a dynamo-electric machine there should be an external resistance not exceeding the resistance of the wire in the machine Hitherto it had been found not economical to increase the resistance in the machine to more than one ohm ; otherwise there was a loss of current through the heating of the coil If, therefore, there was a machine with one ohm resistance, there ought to be a conductor transmitting the power either to the light or the electro-magnetic engine not exceeding one ohm. He then goes magnetic engine not exceeding one ohm." He then goes on to consider that as the conductor is lengthened its cross-section must be increased in proportion to keep the resistance constant at one ohm, and he arrives at a result quite new at the time, viz that if the number of dynamos in parallel were increased in proportion to the length and cross-section of the line. "it was no dearer to transmit electromotive force to the greater than to the smaller distance.

romotive force to the greater than to the smaller distance."

Sir William Thomson grasps at once the novelty and importance of this idea, and renders it even more important by proposing to put all the dynamos in series at one end of the line, and all the lamps in series at the other. But it would still appear that even 40 per cent efficiency for transmission over a considerable distance could only be attained when "there were a sufficient number of be attained when "there were a sunctent number of lamps" to make it necessary to use many dynamos in parallel in accordance with blemens's proposal, or, many dynamos in series in accordance with Thomson's modification of Stemens's proposal.

In 1879, the electric transmission of power was still such a terra incognita that the largest firm of electrical

engineers in Europe could not be induced to tender for transmitting power over ten miles in India

At the British Association lecture in the autumn of 1879, Prof. Ayrton exposed the fallacy of assuming that 50 per cent was the maximum efficiency theoretically obtainable with an electromotor. He further proposed that, instead of employing many dynamos at one end of the line and many lamps at the other, there should be used a single dynamo and a single motor, with much wire on each, that the high potential of the line necessary for economical transmission of power should be maintained by running both dynamo and motor much faster than hitherto, and that both dynamo and motor should be separately excited Although not wholly free from the prevailing idea of that day—that electric transmission of power overlong distances would only be commercially possible when a very large amount of power had to be transmitted—he says, after discussing the subject, "So now we may conclude that the most efficient way to transfer energy electrically is to use a generator producing a high electromotive force and a motor producing a return high electromotive force, and by so doing the waste of power in the transmission ought, consider, to be able to be diminished with our best existing dynamo-electric machines to about 30 per cent."
This was perhaps the first time that it had been even

suggested that the efficiency in electric transmission of

power could be more than 50 per cent.

Further, the lecturer proposed to use in all cases this high E M F. motor, whether the received power were required for motive purposes, for light, or for electroplating, and, as experimentally shown in the lecture, to generate the current locally in the two latter cases by using the motor to drive a suitable dynamo, thus giving the first illustration of the employment of an electric transformer in the actual transmission of power to a distance.

Two years later, viz in 1881, the old mistaken notion, that it was only 50 per cent of the power given to a dynamo that could be returned by the motor, was again propounded during a discussion at the Society of Arts; and the Chairman, Sir W Siemens, when correcting the speaker's error, added, "Experiments of undoubted accuracy had shown that you could obtain 60 or 70 per

cent In this year two very important propositions were put forward—the one, by Sir W Thomson, at the semi-centenary meeting of the British Association, that, in the electric transmission of power, the small current of high potential difference should be employed at the receiving end of the line to charge a large number of accumulators in series, the accumulators being subsequently discharged in parallel for supplying light or power to a town; the other, by MM. Deprez and Carpentier, to use one alternate current transformer at the sending end to raise the electric pressure, and another transformer at the receiving end to lower it down again, the arrangement being symbolically shown in Fig. 1



Fig. 1 - Deprez and Carpenture's Plan of Double Transformation

The great advantage of this combination is, that the pressure along the line may be very high, and the line therefore composed of only thin wire, whereas the pressure between the leads from the generating dynamo at the transmitting end, as well as the pressure between the lamp mains at the receiving end of the line, may be as low as if the dynamo and lamps were close together

In the experiments, however, made in the following year, 1882, to transmit power from Miesbach to Munich, along thirty-five miles of iron telegraph wire o 18 inch in diameter, the current going by one wire and returning by another, M Deprez did not employ his double transform ing arrangement described above, probably because alter nate current motors were then quite untried practically But, instead, he used a direct current dynamo generating a potential difference of some 1500 volts, the current from which set in motion a direct current motor, wound to stand a similar high pressure, placed at the other end of the telegraph line

The experiments were attended with various breakdowns of the dynamo, which was probably constructed on the usual string-and-glue fashion of those days; and finally, after repairs had been effected, the power given out by the motor at Munich was only a fraction of I horse, with a commercial efficiency of about one-third

It was, therefore, decided to repeat the experiments the next year, 1883, with machines constructed more solidly, and for the convenience of the jury the dynamo and motor were placed close together in the workshops of the Northern Railway near Paris, one terminal of each being connected by a short wire, and the other terminals by a telegraph wire 0 157 inch thick going from Paris to Bourget and back again, a distance of 18,133 yards. The power used in driving the dynamo was towards the end of this second set of experiments about 10 horse, and the power given out by the motor about 31 horse, the potential difference at the dynamo terminals being some

The arrangement of the machines was very bittely criticated some pronounced the result a great success, others that the whole thing was a fraud, that the power did not up from the dynamo at Parist Bourget and back again, but that, owing to leakage from one of the telegraph lines to the other, the actual distance over shich the power was transmitted was far less than the distance stated

The next experiments were made with the same machines rewand and improved in insulation. They were now employed to traismit power rove #P miles, from Varille to Greate the same and a connect the dynamic and motion. A difference of potential of hosting you volks was employed, and 7 hoise-power was given off by the motor was a commental of flowing you will be with a commental of flowing you will be with a commental of flowing you for great of the will be with a commental of flowing you for great or with a commental of flowing.

This experiment of transmitting power from Vielle to Grenoble in 1833 was distinctly successful, and constituted a great advance on anything in electric transmission that had been attempted before. It is interesting, for example, to compare it with the transmission from Hirschau to Munich by Mr. Schuckertin 1882, and which was regarded as very stitling at the time if was carried on the second of the secon

Transmission of Power

	1832 Harschau to Munich	Vizille to Grenoble
Distance in miles	32	84
Diameter of conducting wire to inches	o 18	0 079
Horse-power delivered by electromotor	5 8	7
of the transmission	36	62
Potential difference at terminals of dynamo in volts	700	3000

Compaining, then, the Vizille transmission of 1883 with the Hirschau transmission of 1883, we see that the distance was time to expect the cross-section of the wire less than one quartet, the power somewhat greater, and the efficiency nearly twice as great, this preat improvement being effected by using a pressure of 3000 instead of 700 volts.

But with 3000 volts the limit of constructing the commutator of an ordinary direct current dynamo or motor is reached—a fact which was not appreciated by M Depree. For when it was decided somewhat later to try and transmit 200 hore-power through 230 stelegraph poles between Creal and Paris, by using a pressure of 6000 or more volts, the same system of direct current dynamo and motor, that had been employed by M Depres in his previous transmissions, was resorted to. The result was the dynamo and motor were burnt up time after time.

Eventually, after the expenditure of a very large sum of money, spent in several rewindings of the machines, &c., M. Dejrez succeeded in 1886 in obtaining from the shaft of the motor at Pairs 52 lourse power, this being 45 per cent. of the power spent in driving the dynamo at Credi. The power delivered at Pairs was distributed by coupling a low potential differences at Pairs with the Coupling a low potential difference, the dynamo for driving various smaller motors, so by this dynamo for driving various smaller motors, so that the power actually delivered to the pumps, &c., was somewhat less than the 52 hores stated above.

In the use of a dynamo and motor each with a high resistance armature and a low resistance field magnet, the fields being produced by separate excitation, and in the employment of a motor-dynamo for utilizing the received power, M. Depret expressed his approval of the very

NO. 1144, VOL. 44

plan proposed by Profs Ayrton and Perry in 1879 for "sending by even quite a fine wire a small current," and so obtaining "an economic arrangement for the transmission of power

direct current ought to be used. While these various experiments of M. Deprez with direct currents were being carried out, the transmission of power by means of alternating currents lad been prosented on the control of the control

Nobody thought much of the "secondary generator", it seemed to have no very special use, the tron over felt very hot, so that there would be a new waste of power introduced mot electric lighting by the use of secondary for the s

But Messrs Gaulard and Gibbs believed in their secondary generator, whatever electricians and the secondary generator, whatever electricians and the Notting IIII Gate, Edgware Road, Gower Street, King's Cross, and Aligate stations of the Metrupolitan Railwoy, joined the fine wire coils of all the generators in servit one another, and sent a small alternating current through the whole curcuit from a bytome placed the thick wire coils of sach of the generators at the five rulway stations burned steadily and brightly; an alternate current motor, even, which was put at one of the stations, revolved rapidly but what a great waste of your form of the stations, revolved rapidly but what a great waste of your forms of the stations, and the sunce-scany transformation, and

Well, in the spring of the next year, 1884, Dr J Hopkinson tested the efficiency of these secondary generators on the Metropolitan Railway, and, to the surprise of nearly everyone, it came out close on 90 per cent

In the autumn of the same year, in connection with the Exhibition at Turin, power was transmitted to Lanzo, twenty-five miles away, by means of a bare overhead wire rather less than one-quarter of an inch in thickness, and, by means of Gaulard and Gibbs's secondary generators, the foundary of the properties of the transformers was 89 per cent, the whole distribution strikingly successful, and a pute of 10,000 france was awarded to Messrs Gaulard and Gibbs by the Italian Government

No electromotors, however, appear to have been driven by the transmitted power, for, even in 1884, alter-

nating current electromotors were still comparatively untried.

"Tests of a secondary generator were next undertaken in 1855 by Prof Galike Ferrans, of Turn, who found the efficiency at full load to be no less than o'; per cent,—a value even higher than that previously published. This messigation is the more memorable, in that it led Prof. Ferraris to take up the mathematical and experimental investigation of alternating currents, resulting in the discovery and construction of the self starting alternate covery and construction of the self starting alternate experimental investigation of alternating currents, resulting in the discovery and construction of the self starting alternate secondary generators, now called transformer. And so one of the chief lions this year at the Frankfort Exhibition was Prof. Ferraris.

(To be continued.)

THE GIRAFFE AND ITS ALLIES.

ALTHOUGH coming within that well-defined group of ruminants known as the Pecora, the Giraff (the sole existing representative of the genus Giraffa) stands markedly alone among the mammals of the present epoch; although, on the whole, its nearest living relations appear to be the deer (*Cervude*) Moreover, not only is the giraffe now isolated from all other ruminants in respect of its structure, but it is also ex-clusively confined to that part of the African continent which constitutes the Ethiopian region of distributionists. When, however, we turn to the records of past epochs of the earth's history, we find that both the structural and distributional isolation of the giraffe are but features of distributional isolation of things Thus, in regard to its distribution, we find that in the Pliocene epoch giraffes were abundant in Greece, Persia, India, and China, and were abundant in Greece, Persis, india, and China, and we may therefore fairly assume that they were once spread over the greater part of the Palicarctic and Oriental regions Then, again, with regard to their allies, the researches of palicontologists have been gradually bringing to light remains of several large extinct ruminants from various regions, which are more or less nearly related to the giraffe, but whose affinities appear to be so complex and so difficult to decipher, that not only do they remove the stigma of isolation from that animal, but even render it well-nigh impossible to give a definition of the group of more or less graffe-like animals, by which it may be distinguished on the one hand from the deer (Cervidae), and on the other from the antelopes (Bornda) Since an interesting account of a new extinct Graffoid from the Phocene deposits of Maragha in Persia has been recently given by Messrs Rodler and Weithofer in the Denkschriften of the Vienna Academy, the present time is a suitable one to offer a brief résumé of the present state of our knowledge of this aup of animals, and the different views which have been

entertained as to the affinites of some of its members. Among the chef structural pecularities of the graffe, the most noticeable is its great height, which is mainly produced by the excessive length of the neck and himbs. The fore-limbs are, moreover, longer than the hind ones, as is well shown by the crucimistance that the radius, or condition obtains. The shell is more like that of the deer than of any other existing runmants, this being shown by its general contour, and also by the presence of the large unosafied space below the eye, which completely expertise the Hachymal from the nast bore; a consequence of the shell present the shell present the sell of such conditions of the protein studied behind the eyes, fe the particular feeding in the skull of the bony processes arising from the skull of the support of the portion situated behind the eyes, fe the particular feeding.

between the occiput and the eyes, and clothed in the lung animal with skin, are not strictly comparable either with the antiers of the deer or the hort cores experienced by the control of the skill, with which, however, they unite as age advances. The whole of the frontal and nasal region is much swollen and inflated by the development of air-cells between the inner and outer massal bones there is a large oval hillock-like protuberance in the middle line, which is sometimes termed a third horn. This excessive instation of the region of the face of the control of the state of the control of the face of the control of the face of the fa

Since a good deal depends on the similarity between the structure of the molar test of the graffe and those of the extinct runmants in question, it may be well to observe that the characters of the molar test hamong all the runmants are of great importance in classification. Thus, these tested in all the deer, although varying to a sent the same general structure, those of the upper jaw being comparatively short and broad, with a large internal additional column. Then, again, in the Brounds we may notice that each of the several groups into which the antelopes are divided, as well as the goats and sheep and the ozen, are severally distinguished by the characteristic of the same group may approximate more or less closely to that of another, we do not find any instances where one member of a group possesses teeth of a totally different type from those of the other perspectatives of the same group. These facts strongly indicate that, when we meet this fost in unmants having molar teeth of the very wind to strong that there must be a certain amount of relationship between the owners of such teeth.

Another marked peculiarity of the grinffe is that the humerus has a double grove for the biceps muscle, instead of the single one found in ordinary ruminants. In regard to its soft parts, the graffe resembles the deer in the usual absence of the gall-bladder, although its reproductive organs are constructed more on the Boyne type

With these preliminary remarks on some of the structural peculiarities of the graffe, we may proceed to the consideration of its fossil allies. The genus which probably comes mearest to the graffe is the imperfectly known the Phocene of Burna, but to which have been referred meaning the properties of the Punjab. This animal must have been consectably larger than the graffe, and the upper molars and bones from the corresponding beds of the Punjab. This animal must have been consectably larger than the graffe, and the upper molars of their external columns, in which respect they come nearer to the corresponding test the of the like has do those of any other members of the group. The postenor cannon-bone, or mentaturas, assigned to this genus, some elongated and graffe-like than those of any other fossil genus in which this part of the skeleton has been described. The cervical vertebrar are also more elongated and graffe-like than those of any data one of early other fossil genus in which this part of the skeleton has been described. The cervical vertebrar are also more elongated and graffe-like than those of any data one of early other themselves the properties of the skeleton when the corresponding data of the properties of the skeleton when the same than the corresponding that the skeleton has been described.

circumstance that they indicate the existence of an animal to a great extent intermediate between the giraffe and the following genus.

The genus 'Islandsheruum was established upon the remains of a large grafted like rumman from the Pikermi beds of Greece, to which a skull from the Indian Swalks, which had been previously regarded as referable to the female of Swalksherum, proved to belong. The above the stable of the stable of

The animal recently described by Messrs Rodler and Wethofer from the Persian Plococne, for which the bybrid name Aliusphalis has been proposed, tends to connect the Idealochiere with the deer, and more established the server in the deer, and more established the server in the server in the server in the health of the radius and ulm being nearly the same. Then, again, from the total absence of nir-cells in the frontal region of the skull, the middle of the face is nearly flat, and the orbits have their frontal borders in the plane of the face, and still more so in the granter. There is, however, no unossified space in front of the eye, although the whole contour of the skull is strikingly eli-like

The conclusion to be drawn from these hornless forms appears to be that they serve to connect the graffe with less absertant ruminatists, and more especially the Corvoids, and the control of the control of the corvoids and the probability and acquired country in the control of the control o

Leaving now these hornless forms, as to the affinities of which there has been no dispute, we have to turn our attention to another group provided with cranial appendages of very curious and still imperfectly understood structure, in regard to whose relationship exceedingly different views have been entertained. This group, so far as we know at present, seems to be confined to the Phocene of India and Persia, being represented in the former area by the gigantic Sivatherium, Bramatherium, and Hydaspitherium, and in the latter by the much smaller Urmiatherium In all these animals the skull is characterized by the extreme shortness of the parietal region, and the position of the horns or antlers immediately over the occiput; the elevated facial profile thus produced being in very striking contrast to the straight one of the deer. In Bramatherium and Hydaspitherium the cranial appendages rise from a massive common base, and the latter genus is distinguished from all the others by the presence of an unossified space below the eye, corresponding to that of the graffe. Their molar teeth are very similar to those of the Helladothere. In the Sivathere, on the other hand, there is one pair of large branching and palmated cranial appendages rising from separate bases imme-diately above the occiput; and in addition to these a pair of much smaller conical ones placed immediately over the orbits In general appearance the large palmated appendages are more like the antiers of the elk than those of any other existing ruminants, but the absence of a "burr" at their base indicates that they were not deciduous, while the deep arterial grooves on their surface suggest that they were clothed either with skin or with a horny substance. The molar teeth conform to those of the giraffe-and to a less degree the deer-having the same rugose enamel: but the ridges on the outer surfaces of those of the upper iaw are more developed than in the other extinct genera. A pecularly giraffe-like and cervine feature in these upper teeth is the extension of the anterior extremity of the anterior crescent far towards the outer side of the crown Lastly, the humerus of the Swathere resembles that of the giraffe in the presence of a double groove for the biceps muscle, while the form of the terminal bones of the feet is almost identical in the two animals. In the small Persian Urmiatherium, which is known only by the hinder portion of the skull, it appears that the cranial appendages consisted of a pair of unbranched, somewhat compressed, and upright processes rising immediately above the occiput

With regard to the affinities of this group, it has been argued that the shortness of the parietal region of the skull, and the position of the cranial appendages immediately above the occiput, indicate affinity with certain African antelopes, such as the Sassabi and its kindred (Aliceaphus). In that group of antelopes it is, however, perfectly clear that the features in question are acquired ones, the allied Blessbok scarcely possessing them in any degree. Again, the straightness of the cranial axis in the skull of Waller's gazelle (Gazella svaller) shows that the arching of this axis, which is so characteristic of most antelopes, is likewise a feature specially acquired among that group of animals Moreover, apart from this evidence, no one who thinks for a moment on the sub-ject can believe that the Sassabi, with its narrow sheeplike molars and true horns, and the Sivathere, with its broad giraffe-like molars and cranial appendages, which are neither true horns nor true antiers, can be anything approaching to first cousins, and yet if they are not so, it is perfectly evident that the similarity in the structure of their skulls must have been independently acquired. It is therefore abundantly clear that no arguments based on these resemblances will hold water, the true explana-tion probably being that the superficial similarity of their skulls its solely connected with the support of cranial appendages having a similar position in both groups

It follows from this that, if a type of skull with a short parteal region, a curved basia axis, and horns placed immediately over the occupit, has been independently parteal region, a curved basia axis, and horns placed immediately over the occupit, has been independently along parteal reson, between the said axis, and horns placed over the orbits, there is no conceivable reason why a similar line of development should not have takens place among graffe-like animals. Taking, therefore, into teeth like those of the graffe, that their cranal appendages could be derived from those of the latter by special modification and development better than from those teeth like those of the graffe, that their cranal appendages could be derived from those of the latter by special modification and development better than from those the said of the sa

The writer has purposely refrained from making any reference to the large unossified suborbital vacuity in the skull of the Hydaspithere, as reasons have already been

526

given for regarding that feature as an acquired one If, however, that view be incorrect, the presence of this vacuuty at once studies the statement that the Sivathere can have no kinship with the giraffe and the deer, on account of the absence of a similar vacuuty, and its presence, so far as it goes, is also another argument against the Sassabi theory.

"The last representative of the Girafford animals that we have to mention is the recently discovered Sametherium, from the Phocene of Samos, a figure of the skull of which appeared in NATURE, illustrating an article on the extinct mammals of those deposits. In this animal, the elongated form and straight profile characteristic of offerm and straight profile characteristic of almost indistinguishable from those of the latter. There is, however, no development of air-cells in the bones of the frontal region, so that the upper border of the orbit is approximated to the plane of the face, and the cranial appendages take the form of upright compressed propendages, which appear to have been inseparable from the bones of the forchead, are, indeed, very similar, both in form and position, to the horn coses of certain extinct antelopes, but we are, of course, unacquainted with the anative of their covering. If, however, as seems to be enaute of their covering. If, however, as seems to be anative of their covering. If, however, as resents to be anative of their covering. If, however, as resents to be anative of their covering. If, however, as resents to be accessed as the seems to be such as the covering of the properties of the such as the covering of the properties as one independently forcid resemblance to the antelopes as one independently.

acquired
Finally, if the views expressed above are anywhere near the truth, it would appear that, in the Phocene epoch, Grafford animals played a very important relleament of the property of

PHOTOGRAPHIC MAGNITUDES OF STARS.

THE character of the image of a six photographed on a sensitude film, three-iten between the intensity of the light photographed and the blackened disk produced, the indience of the time of exposure on the image—are questions now receiving much attention. For this reason, Dr. Schiener's contribution to the subject, embiracing, as if does, the latest results of the Fotsdam will not be accepted without great reserve, contravening, as they do, a theory, or at least an assertion, that has been very generally accepted, vir that increasing the intensity of light is exactly equivalent to increasing the intensity of light is exactly equivalent to increasing the intensity of light is exactly equivalent to increasing the intensity of light is exactly equivalent to increasing the intensity of light is received.

Such a law cannot be rigorously exact, and its stoutest supporters have been careful to confine its application "within limits." But Dr Schemer's contention is that, owing to the complex character of the disk produced on the filtingatch a principle is a very unsafe guide, either as a rule for the determination of the feebbear magnitude impressed on the negative, or as offering a satisfactory explanation of the growth of the dameter or area.

In the first place, there is evidence of want of uniformity of actinic action throughout the whole extent of the stellar disk. A mean intensity (i) may be assumed at a certain distance (r) from the centre of the image, where the intensity is 1. This centre will not be a geometric distance (r) and the centre of the intensity of the intensity of the current of the intensity of the current of the intensity (r) at distance (r) will depend materially on the increase of the area (p), which may be represented by $\psi(p)$. Consequently, the simplest expression for $-1\psi(p)e^{\mu r}$, where a is the confliction of absorption formed on the same emulsion, and treated by the same developer, this cryptession become

$$\frac{I_0}{I_1} = \frac{I_1}{I_0} \frac{\psi(\rho_i)}{\psi(\rho_0)} e^{a(r_1 - r_0)},$$

and, if the disks be on the same plate, $\rho_1 = \rho_0$ and $t_1 = t_0$, so that the formula can be simplified to

$$a(r_0 - r_1) = \log \frac{l_1}{l_0} - \frac{0.4}{\text{mod}} (m_1 - m_0)$$

In order to derive the relation between diameters and exposure, put $I_o = I_i$, and then

$$\log \frac{t_0}{t} = a(r_1 - r_0)$$

It is not likely that such an expression has any other value than to serve as a convenient formula for interpolation. The variable character of a under different conditions, but always depending on the time of exposure, is shown by the following table.

1 xp	Ostire	Instrument	a	Instrument	a
t ut		Reflector	4 99	5 in refractor	4'12
2	0	,,	4 57	**	5 09
8	0	**	4 67	**	5 47
	0	**	4 89	**	5 89
16	0	,,	5 39	13-in refractor	7 51
0	24	13-in refractor		13-in refractor	
	0	,,	3 16	,,	2 20
	30	,,	3 33	11	2 48
6	15	**	3 33	,,,	3 00
15	28		4 48		****

Another well known formula in which magnitude is made to depend on diameter is $m=a-b\log D$, and in this case b is shown, notwithstanding Dr. Charlier's results to the contrary, to be a function of the time of exposure The results are as follows.

Time of	Charber	Time of exposure.	Scheiner
h m	Chartier	m s	Generati
0 13	6 719	0 24	5 17
1 30	6 779	1 0	6.32
2 0	6 683	2 30	7 06
3 0	6 814	6 15	8 o8

The disagreement is conspicuous, but the explanation offered by Dr. Schemer is scarcely satisfactory. He would ascribe the constancy in the value of \(\ell \), found by Pr Charlier, to the fact that in his experiments there is always a large absolute value of the tume coefficient. It can be always a large absolute value of the tume coefficient of the company of t

If it be admitted that the product of intensity by the time is not a constant quantity, it becomes a matter of great practical importance to determine what is gained on a photographic plate by prolonged exposure. This question forms the real investigation of Dr. Scheiner's two papers, and though some of his results may be questioned, yet the general issue is so grave and disquieting that it may not be utterly ignored. Passing over the details of his method of examination, and the precautions taken to mayer accurate results, for which the reputation

of the Potsdam Observatory is a sufficient guarantee, Dr. Schemer presents the following table, in which is exhibited the faintest magnitude which, under certain varied circumstances, can be detected on a photographic nlate.—

	Time of ex	posure,		Faintest	magnitude	
	ın		Plate I	Plue II	Plate 11t	Plate IV
	0 :	24	90	64	7 7	8 2
	1	0	9.4	7 25	8 3	8 75
	2	30	99	7.7	8 55	93
٠	6	15	10 6	8 45	9.3	965
	15	38	****	8 85	9.7	

It will be noticed that while each successive exposure is 25 that of the pieceding, the corresponding gain in light is considerably less than one magnitude From each of the four plates the gain is as follows.—

The mean is 053—that is to say, instead of one magnitude being gained by continued exposure through each successive interval, the actual gain is only half a magnitude The exception that might be taken to these experiments is, that the detection of the feeblest stars on a plate is a matter of doubt and great practical difficulty. Dr Scheiner has, however, availed himself of a second To Scientific mass, nowever, availed infinise of a second test by counting the stars on a plate after various exposures. With this view two plates were taken of the region round of Orionis, one with an exposure of one hour, the other with eight hours' exposure. Therefore, if 25 the other with eight hours' exposure. Therefore, if 2 5 times the exposure produced stars a magnitude fainter. times the exposure produced stars a magnitude radiiter, there ought to be a gain of more than two magnitudes on the second plate, and it may be assumed that the number of stars impressed would follow the known law. On the one-hour plate were found 1174 stars, on the eight-hour There ought to have been on the long-exposed plate over 10,000 stars, so that roughly speaking only onehalf of the stars given by the law were photographed Further, Argelander has catalogued within this area 125 stars, and therefore it might have been anticipated from the law of increase that some 10,000 stars would have been visible on the one-hour plate

This margin is too great to be readily explained away of course, there is the same difficulty in perceiving the mutte dots that represent the faintest stars as in the former case, and further, it is possible that the law of average increase of the number of stars did not hold in a verage increase of the number of stars did not hold in that a law, which applies with more or less accuracy on the average to the whole of the sky, is necessarily fulfied on any small portion, such as the ten-thousandth part. If the stars are not in the heavens, they cannot be photographed. Evidently, it would be unlikely that thousandth part of the total number of stars impressed. But allowing for errors of exaggeration and observa-

But allowing for errors of exaggeration and observation, the result is very interesting, and not a little alarming as implying that sphotography is not so powerful an engine as was at first anticipated, and that, to accomplish the full hope of all that was expected of it, longer exposure and consequently a greater expenditure of time will be that if a star of the 95 mag be registered in 44 seconds, then in 150 minutes a star of the 165 mag will be photographed, supposing a whole magnitude to be gained by successively multiplying the exposure by 2 5 but if the gain be only 05 in this interval, then the fanites's star impressed will be only 130 mag, even after this long that of the 150 mag, but the continue of the 150 mag. The the 150 mag will be solony 150 mag, even the tribusion of the that of the 150 mag. The the 150 mag will be solony to the 150 mag. The truth will probably be found near this latter limit. NOTES

This econd International Folk Love Congress meets at the rooms of the Society of Antiquaries this afternoon, when an address will be delivered by Mr. Andrew Lang, the President, Three subjects are to be considered—folk tales, mythology, and mutations and customs. To each of these subjects a day will be devoted. The proceedings will be brought to an end on Wednesday morning next.

1111 Iron and Steel Institute will meet at the Woolwich Arcent on Tuesday nest. The members are to be conducted over the manufacturing departments at the Arsenal, and will see quick firing and machine guns in practice. On the following day the Institute will conclude its meeting at the Institution of Civil Regineers.

First third blennial session of the International Statistical Congress was opened at Victina, on Monday, by Baron Gautsch, the Austrain Minister of Public Instruction An address was delivered by Sir Rawson, the President

This seventeenth Annual Congress of the Santary Association of Socioland was held in Fullmolly last week. Dr. Farquhar son, M.P., President of the Congress, delivered an address "On a Nobel Hygienes State, or a Galinear at the Santation of the Future." In the course of his remarks he urged the necessity for more organized attention being given in Parliament to Mygienic matters, and advocated the appointment of a Minister of Pablic Leading and Congress of the Congress of the

THE Harveian Oration will be delivered at the Royal College of Physicians, by Dr. W. II. Dickinson, at the Royal College of Physicians, on Monday, October 19, at 4 o'clock

WE referred last week to the death of Prof W Ferrel was born on January 29, 1817, and since the foundation of the American Meteorological Yournal he was a frequent contributor to that paper, from which we take most of the following details of his life. During his boyhood he was kept rather closely at work on his father's farm, and with the first money he earned, he bought a copy of Park's "Arithmetic" Having also a liking for istronomical studies, he used to draw a number of diagrams upon the doors of his father's farm, describing circles with the prongs of a pitchfork. In 1839, he entered one of the Colleges in Pennsylvania, and graduated at Bethany College in 1844. In 1857, he became an assistant in the office of the "American I phemeris and Nautical Almanac," and subsequently entered the U.S. Coast Survey and the Signal Office, from which last he retired in 1886. He was elected a member of the National Academy of Sciences in 1868 Ferrel is described as an extremely diffident man, and he never once sought position, every official position that he occupied having been offered to him His first paper bearing directly on meteorology was published in 1856, with reference to the deflective effects of the earth's rotation upon the motions of the atmosphere; and this paper, which has done much towards establishing meteorology on a scientific basis, was subsequently revised and reprinted as one of the professional papers of the Signal Service, under the title "Motions of Fluids and Solids on the Earth's Surface" In this treatise he proposed a complete analytical investigation of the general motions of the fluids surrounding the earth These papers received considerable attention and discussion soon after publication, especially in France, in America and England they were overlooked until recent years, but they are now recognized as fundamental propositions in the study of meteorology. He also wrote various articles on the tides, which are of equal significance with those on the motions of the aimosphere, and he constructed a "maxima and minima tidepredicting machine." which is now in use at the Coast Survey Office in Washington The last of his numerous works upon meteorology was a "Popular Treatise on the Winds," published

in 1889, and reviewed at length in our columns (vol xli, p. 124). In this work he has explained at length, and with great clearness, many points which in his other writings have been too mathematical to allow of their being generally understood.

WE have already recorded with regret that Miss E. A. Ormerod has considered it desirable to resign her post of Consulting Entomologist of the Royal Agricultural Society, which she has occupied for about nine years, having been appointed in 1882 We understand that her reasons for resignation are partly on account of health, as in wet and cold weather she cannot take the requisite journeys to attend Committees without risk; partly on account of claims made of power of Council to direct her to render service in reporting elsewhere, and claims also made as to use of information in her possession beyond what the terms of her engagement granted These claims, we understand, have been withdrawn, but Miss Ormerod considers she can work more efficiently when freed from the anxieties and possible ties which public office necessarily brings with it. Miss Ormerod's agricultural entomological work, as shown by her annual reports has now been going on steadily for at least fourteen years, having been begun several years before she was elected to the staff of the Royal Agricultural Society, and this she purposes to continue precisely as before in all respects, whether as regards replies to inquiries, or publication by herself of observations in the form of yearly reports

In an article on Hooker's, "Icones Plantarium," in our last issue (p 498) we attributed the plates of the earlier volumes to Sir William Hooker Sir Joseph Hooker informs us that they are all the work of Mr. W. H. Pitch

A VALUABLE report, by Mr A E Shipley, on an orange disease in Cyprus, caused by a scale insect, is published in the September number of the Kew Bulletin The disease appears to have been noticed in Cyprus for the last six or eight years. The particular insect to which it is due is Aspidiotus aurantis, Maskell, a member of the sub-family Diastonic, which with some others, compose the family Coccide. Mr Shipley gives an account of the life-history of this insect, and then describes the various methods of dealing with it. The most successful of these methods is the gas treatment, a full description of which, by Mr Coquillett, Is quoted by Mr Shipley from Bulletin No 23 of the U.S. Department of Agriculture, Division of Entomology. We may note that Mr Shipley is anxious to obtain examples of Cocoda which infest plants, and examples of nematode worms parasitic in plants, with the affected parts of their respective hosts.

THE Kew Bulletin for September, besides Mr. Shipley's report on orange scale in Cypria, contains sections on the reducovery of gutta-percha trees at Singapore, on a new process for recovering some portion of the gutta-percha which is left in the bark of the trees after collection by the ordinary native method, on the fodder plant Tagassate, and on Kangra buckwheet.

THE Oesterreschische Botanische Zeitung for September contains a report of Dr. A. v Degen's botanical excursion to the island of Samothrace, and of Dr. R. F. Solla's to Southern Istria.

This fourth number of the first volume of Contributions from the U.S. National Harberium, published under the suspices of the Department of Agriculture at Washington, consists of a description, by Mr. J. N. Rose, of the plants collected by Dr. E. Palmer in 1890 in Western Mexico and Arzona. Forty-fire ever species are described, and several of these are tillungrated by plates. Most of the new species obtained were from the neighborarhood of Alamon, a miling town of about 10,000

mhabitants, sunated 180 miles south-east from Guaymas, at an altitude of about 1275 feet, where there are both a dip spring and a ramy autumn flora, very different from one another. Dr. Palmer has again started for a year's exploration of Western Mexico

SOME valuable and interesting notes on the fertilization of Sonth African and Mandgascar forbering plants by Mr G. F. Sont Elliot, appear in Armale of Botary (vol. v., No. xix, August 1891), and have also been issued separately. They represent much work done during a two years' botanical trip. While travelling, Mr Elliot found it impossible to make as thorough and complete observations as are really required for a proper comprehension of all the adaptation of a flower to invested in the section of the section of the daptacetion of all the adaptation of a flower to investing flowers, and brought home with him a numbered collection Mort of the forms secured by him had not previously been studied in their native haunt.

THE TRANSACIONS of the Laverpool Biological Society for 189; contain an important paper by Mr. G Muray on the Distribution of Manne Algevin space and in time. The author compares the agial flow of three widely separated regions—the Arctic Sea, the West Indian region, and Australia, and shows in a table how many genera and species are common to any two of the regions. The number of Knows species of seaweds is given as 259 in the Arctic Sea, 585 in the West Indian, and 1133 in a Australia. Only twelve species are common to all three regions, and of these four belong to the Ulwin Indian.

A GREAT Mining Exhibition is to be opened at Johannesburg next July, and exhibits from all parts of the world are invited

This administration report of the Manne Survey of India for the official year 1850-0-1, by Captum R F Hoskyn, has been published. For some time notices had been received from several vessels, which seemed to indicate that the shoals Jung off the eastern coast between Ensore and Pulscat were extending seward. In the early part of 1850, therefore, the Parentinguer proceeded to the neighbourhood, and made a survey of the coast between these two places, carrying the soundings out to the too-fathom line. The result aboved that no material change that had been seen to the seven the server of the server of the theory of the coast of the server o

THE report of Dr. A. Alcock, surgeon-naturalist on board the Investigator, is one of great interest. It is given as an appendix to that of Captain Hoskyn. We have already referred to Dr. Alcock's account of the general results of his deep-sea work It may be noted that on November 3, 1890, the deepest haul ever made in Indian seas-1,997 fathoms-was successfully carned out in lat. 9° 34' N., long. 85° 43' 15" E., the bottom being Globigerina ooze with pieces of water worn pumice, and the bottom temperature being 35° F. About 2200 fathoms of wire were veered. The following was the entire take .- There were three species of sillceous sponges and numerous detached spicules of Hyalonema, a large sea-anemone of a salmon-pink colour, with bright red tentacles; a mutilated specimen of the Brisingoid Freyella benthophila, Sladen, a fine new species of Hyphalaster, and a small, probably new, species of Marupaster with the midamental pouches widely open and full of ova; two species of Ophinrids, one of which is Ophiomastus, three species of Holothurians including Echinosoma; numerous specimens of a long-stalked Ascidian; two specimens of a very large species of Amphipod, a blind Crangonld, three species of macrurous Crustaceans, and a small Scapellum; a small Lamellibranch; and a number of empty annelid tubes, some of which were constructed of Foraminiera shells, while others consisted of agglutinated silky (siliceous) threads

Ms. W. L. Dallas, assistant meteorological reporter to the Gorenment of India, has written a valuable paper on the meteorology and climatology of Northern Afghanstan, the facts having here collected by offices, and the Afghan having here collected by offices, and the Afghan the consideration. Taking the wind like Afghan the consideration, Mr Dallas thus it may visible be mint atmed that in the great majority of cases the disturbed wealthe which appears over North Western India during the winter and spring months is the result of disturbances, which either effect assimilations of the whole region comprising Afghansian. Balachstan, and North-Western India, of which have appeared first over Afghansian and secondly over India, and that these disturbances have seldom originated in India stelf or asseconfied to India.

WE have received from the Meteorological Council their Quarterly Weather Report for July to December 1880, and Monthly Weather Report for May to December 1887 Quarterly Reports, which commenced with the year 1860. contain, in addition to the monthly and five-daily means of the observations made at the seven observatorics, plates of the continuous curves of the self-recording instruments, which have been etched at the Office, and are perhaps the most complete and perfect series of meteorological curves hitherto published, and also a condensed account of the most important meteoro logical changes of the period The Quarterly Reports are now discontinued, and the publication of a Monthly Weather Report was undertaken in 1884 in substitution for the Onarterly Report, while the hourly observations and means have been published in a separate volume. This Report contains the results of obwith a chronicle of the weather, and charts showing the average conditions of the various elements. Both the Quarterly and Monthly Weather Reports also contain a number of claborate discussions of various allied subjects The Monthly Reports in the form hitherto issued have been modified, and instead of appearing as a separate work, a Monthly Summary of the Weather, on a more concise plan, has been added to the Weekly Weather Report, commencing with the year 1888 With the exception of the years 1881-83 we have therefore a continuous and valuable record of the weather-in addition to such as is afforded by the Daily and Weekly Reports-since 1869, and we believe it is the Intention of the Council to connect the gap between the Quarterly and Monthly Reports at an early date, by a discussion of the weather for that period. We shall refer in a future number to the publications which deal with the observations and results at the Stations of the Second Order, which are more particularly of a climatological character, without discussions of current weather.

The Park Communication of Boston, U.S., have set apart three parcels of land for the testablishment, by the Boston Society of Natural History, of soological gardens and aquasis. It is essential that soo, coo dollars should be raised before may stempt can be made to realize the scheme as a whole, but if a third of the amount were subscribed, one of the two proposed aquasis might at once he instituted. An appeal has been made by the Society to the people of Boston for the necessary finds, and it will be strange if it does not more made, but have a subscribed to the scheme that the state of the people of Boston for the necessary finds, and it will be strange if it does not more made, but his that care public-pipirted client will see in the scheme "an addition to the forces which increase the intelligence of the voter, and thereby tent to make Boston a more desurable place of readence."

STUDENTS of the Ice Age will read with interest a paper by Mr. N. S. Shaler on the antiquity of the last glacial period, submitted to the Boston Society of Natural History, and

printed in the latest instalment of the Society's Proceedings. Mr Shaler differs decidedly from those geologists who suppose that the end of the glacial period is probably not very remote from our own day. One of the strongest of his arguments is derived from the distribution of the vegetation which in America has regained possession, by migration, of the glaciated district. We must conceive he points out, that as the ice retreated and gradually disappeared from the surface a considerable time claused before existing forests attained their organization. He assumes as certain that the black walnut and the pignut bickory, between Western Minnesota and the Atlantic coast, have advanced, on the average, a distance of 400 miles north of the ancient icc front to which their ancestors were driven by the presence of the glacial sheet For several reasons he believes that the northward progress of these forms must have been due mainly, not to the action of streams or tornadoes, but to the natural spread of the seed from the extremities of boughs, and to the carriage of the seed by rodents. But allowing for every conceivable method of transportation, he argues that a period of ten or even twenty thousand years is wholly inadequate to account for the present distribution of those large-seeded trees. If they occurred only sporadically in the northernmost part of the field they occupy, their implantation might be regarded as due to chance action. I he fact, however, that they extend from the Atlantic to Minnesola indicates that the advance was accomplished by causes of a general and continuous nature

"WATER BIRDS that live in the Woods" formed the subject of an interesting paper read lately by Mr. C. B. Sennett before the Linnesn Society of New York About a dozen species were dealt with, the most interesting of them perhaps being the tree ducks (Dendrocygna autumnalis et fulva) The former is found in the heaviest timber along the Rio Grande of Texasat Lomita, and as this river furnishes no sort of food, it adapts itself to circumstances and leeds upon seeds or grain ducks will alight upon a stalk of growing corn with the ease of a blackbird, and are quite at home among the lofty trees where they make their nests. They do not resort to the river, which is so cold and muddy, from the melting snows of the mountains whence it flows, that all vegetable and animal life save the garpike is wanting. No ducks of any kind are found upon it. flock of cormorants, about four miles long and one mile and a half wide, was once seen by Mr Sennett in Minnesota.

SPARROWS do not seem to lose in New Zealand any of the audacity for which they are famous in Europe. In a paper read some time ago before the New Zealand Institute, and now printed in the Transactions, Mr T W Kirk gives an example of what he calls their "daring and cool impudence" Between I catherston and Martinborough he heard one day a most unusual noise, as though all the small birds in the country had joined in one grand quarrel Looking up, he saw a large hawk (C goulds-a carrion-feeder) being buffeted by a flock of sparrows. They kept dashing at him in scores, and from all points at once. The unfortunate bawk was quite powerless, indeed, he seemed to have no heart left, for he did not attempt to retaliste, and his defence was of the feeblest. At last, approaching some scrub, he made a rush indicative of a forlorn hope, gained the shelter, and there remained. Mr. Kirk watched for fully half an hour, but he did not reappear. The sparrowa congregated in groups about the bushes, keeping up a constant chattering and noise, evidently on the look-out for the enemy, and congratulating themselves upon having secured a victory.

If we may judge from the Report of the Department of Agriculture, Victoria, for the year 1889-90, the farmers of that colony are likely to benefit largely by the work of the agricultural authorities. The Department is efficiently organized, and has a thoroughly scientific conceition of the nature of its duties. Mr D McAlpine, who has been appointed consulting vegetable pathologist, presents the following summary of the tasks undertaken by his particular section (1) special investigations concerning the rust of wheat, oats, barley, and other cereals, and, connected with that, the question of rust on various grasses-native and imported, (2) investigations of the life histories of the various fungus pests, and a knowledge of the best time to cope with them . (3) reports upon diseased specimens sent in from different parts of the colony, and the best known remedies for the palliation or prevention of such diseases . (4) collection of specimens of the various diseases due to fungi, and the subsequent formation of a museum for educational purposes. (5) delivery of lectures in different centres on the fungus pests most prevalent there . (6) preparation of illustrated handbooks, describing the nature of the various diseases and the remedies to be employed where possible, (7) testing various functiones and the best methods of applying them. (8) visiting different districts in order to find out prevailing and invisions fungi. (9) contributing periodic reports to the official Bulletin of the Department.

In the Proceedings of the Bath Natural History and Antiquaran Field Cab (ed. No. 19, M. J. F. Mostry, Clarke gives an account of the geological fornations exposed in the cuttings of the Bridgaueter Railway, the construction of which opened up a continuous line of eccavation through the heart of the Polden Hills Mr. Clarke had charge of the construction of the railway until near the completion of the earthwork, so that he had excellent opportunities for making careful observations. Geologists may be glad to have had description of the strats when the ologies of the cuttings are overground.

MESSRS LONGMANS, GREFN, AND CO have published the sixth edition of "An Elementary Treative on the Integral Calculus," by Dr Benjamin Williamson, F.R.S. In this edition the work has been revised and enlarged

MESSES. MITSCHER AND ROSEELL, 61a Jagerstrasse, Berlin, have issued an important list of books which they have for sale. The works relate to the various departments of botany

Two communications upon the volatile carbonyl compounds of platinum, from Dr. Pullinger, of Tubingen, and Drs. Mylius and Foerster, of Charlottenburg, appear in the last number of the Berichte Since the preparation of the remarkable carbonyl compounds of nickel and iron by Messey, Mond, Langer, and Quincke, these platinum compounds, discovered by Schutzenberger in the year 1868, have become more interesting, and the two papers now before us add considerably to our knowledge of They are compounds containing platinum, chlorine, and carbon monoxide, and Schutzenberger assigned to them the formulæ PtClaCO, PtCla 2CO, and 2PtCla 3CO respectively He obtained them by heating spongy platinum to a temperature of 250° C in a stream first of chlorine and afterwards of carbon monoxide The volatile, readily fusible, and crystalline sublimate obtained contained a mixture of the three, and he effected a separation by extraction with carbon tetrachloride, in which the three compounds are differently soluble. They are well defined by their melting-points, which are 194°, 142°, and 130° C respectively. They are decomposed by water with separation of plaunum, formation of hydrochloric acid, and evolution of carbon dioxide, and also, in case of the second and third compounds, of carbon monoxide. The most stable of these compounds and the best investigated is the simpler one, COPtCl. It appears to possess a distinctly basic character, so that it is able to combine with hydrochloric acid to form a compound, COPtCl_a HCl; this compound is formed in solution when the crystals are dissolved in concentrated hydrochloric acid The two other compounds are decomposed by hydrochloric acid, losing carbon monoxide and forming the hydrochloride of the first compound. On evaporation of

the hydrochloric solution, the first compound is left in needleshaped crystals. When phospene gas, COCL, is passed over the crystals, drops of liquid are formed, which consist of a solution of the compound in liquefied carbonyl chloride. In addition to these compounds, the bromide and todide corresponding to the compound COPtCl, have been prepared. When the hydrochloric acid solution of the latter is evaporated on a waterbath in a stream of hydrobromic acid gas, and the resulting compound extracted with benzene, the filtered solution deposits, on cooling, orange-red needles of the bromile, COPtBr. The bromide has likewise been obtained by Dr Pullinger, by passing carbon monoxide over heated platinous bromide Similarly, the iodide has been prepared by evaporating crystals of the chloride with excess of hydriodic acid solution, and treating the residue with warm benzene. The crystals of the sodide. COPtIa, which separate from the benzene solution on cooling, are deep red in colour, with a violet surface reflection. The chloride, bromide, and todide exhibit a beautifully graduated difference of properties Thus the chloride is vellow. the bromide orange, and the iodide red in colour. The meltingpoints are 194°, 181°, and 140° respectively. The chloride is readily, the bromide difficultly, and the iodide not at all volatile The chloride is strongly hygroscopic, the bromtde less so, and the jodide permanent. In addition to these compounds, another has been obtained by Dr. Pullinger, of the composition PtCl. 2COCl., in the form of non volatile vellow crystals. readily soluble in water, from which it recrystallizes unchanged, It appears to be the most stable of all these platinum compounds,

OUR ASTRONOMICAL COLUMN.

but is only obtained in very small quantity

INTURNICE OF ABERATION UPON OBSERVATIONS OF SOLAR PROVINENCES—Some recent observations of the development and movement of solar prominences have led M. Fizzar to consider the militare that the abertation of light may eserted the consideration of the properties of the consideration of the consideration of the consideration of the consequence of abertation, the longitude of the san, and therefore of the prominences, a diminished by the amount of the carth's orbital velocity. And it results from this that if a prominence is developed in the neighbourhood of the celliptic of the carth's orbital velocity. And it is results from this that if a prominence is developed in the neighbourhood of the celliptic of the carth's orbital velocity. And it is composed has a velocity and the luminous matter of which it is composed has a velocity postion will saffer a displacement of 20° 425, which may be dided to the effect due to the earth's motion, or otherwise, according to the direction of piopagation, and thus give rise to corresponding remainor with distance from the edge of the sun. Not the contraction of the c

Another point touched upon in the communication to which reference has been made is the physical nature of promin ences. The simplest hypothesis is that they represent clouds of incande-cent hydrogen and other metallic vapours, but Fizeau favours the idea that their visibility is the result of the passage of electrical discharges through gascous material.

NEW ASTEROIDS.—The 317th asteroid was discovered by Charlois on September 8, and the 318th on September 11

SOME OF THE POSSIBILITIES OF ECONOMIC BOTANY!

OUR Association demands of its President, on his retirement from office, some account of matters connected with the department of science in which he is engaged The subject which I have selected for the valedictory address

I he subject which I have selected for the valedictory address.

Association for the Presidential address delivered before the American Association for the Advancement of Science, as Washington, August 1891, by George Lincoln Goodale, M. D., L.D., Fisher Pr. fessor of Natural History, Harvard Unreversity, Cambridge, Mass., U.S.A.

deals with certain industrial, commercial, and economic questions revertheless it lies wholly within the domain of botany I invite you to examine with me some of the possibilities of economic botany

Of course, when treating a topic which is so largely speculative as this, it is difficult and unwise to draw a hard and fast line between possibilities and probabilities. Nowadays possi bilities are so often realized rapidly that they become accom-

Dished facts before we are aware.

In asking what are the possibilities that other plants the those we now use may be utilized we enter upon a many sided ask what plants the coming man will use?

There is an enormous disproportion between the total number of species of plants known to botanical science and the number of those which are employed by man

The species of flowering plants already described and named are about one hundred and seven thousand. Acquisitions from unexplored or imperfectly explored regions may increase the aggregate perhaps one-tenth, so that we are within very safe limits in taking the number of existing species to be somewhat

above one hundred and ten thousand Now if we should make a comprehensive list of all the flowering plants which are cultivated on what we may call a fairly large scale at the present day, placing therein all food and terry large scale at the present day, placing therein all lood and forage plants, all those which are grown for timber and calinet woods, for fibres and cordage, for timing materials, dye, reans, rubber, gums, oils, perfunes, and medicines, we could bring together barely three hundred species. If we should said to this short catalogue all the species, which, without cultivation can be used by man, we should find it considerably lengthened can be used by man, we should find it considerably lengthened A great inney products of the classes just referred to at cleaved in commerce from wild plants, but exactly how much their addition would extend the list. It is impossible in the present state, of knowledge to determine. Every enumeration of this character is I kely to contain a riots from two sources first, it would be sare to continue some species which have outlived them. real usefulness, and, secondly, owing to the chaotic condition of the literature of the subject, omissions would occur

But after all proper exclusions and additions have been made. the total number of species of flowering plants utilized to any considerable extent by man in his civilized state does not exceed,

In fact it does not quite reach, one per cent
The disproportion between the plants which are known and those which are used becomes much greater when we take into account the species of flowerless plants also. Of the five hundred ferns and their allies we employ for other than decotative purposes only five, the mosses and liverworts, roughly estimated at five hundred species, lave only four which are directly used by man. There are comparatively few Algæ, Fungi, or I ichens

man I nere are comparatively lew Alge, Fungi, of Telection which have extended use.

Therefore, when we take the flowering and flowerless together, the percentage of utilized plants falls far below the estimate made for the flowering alone.

Such a ratio between the number of species known and the number used justifies the inquiry which I have proposed for discussion at this time—namely, can the short list of useful plants be increased to advantage? If so, how?

This is a practical question, it is likewise a very old one one form of another, by one people or another, it has been asked from early times. In the dawn of civilization, mankind inherited from savage ancestors certain plants, which had been found amenable to simple cultivation and the products of these plants supplemented the spoils of the chase and of the sea. The pusses suppresented the spots of the chave and of life sea. The question which we ask now was asked then. Wild plants were examined for new users, primitive signiculture and noticultural extended their hounds in an-wer're this impury. Age fiver are has added slowly and cautomaly to the last of callurable and unlaable plants, but the aggregate additions have been, as we have seen, comparatively slight

The question has thus no charm of novelty, but it is as practical to day as in early ages. In fact, at the present time, in view of all the appliances at the command of modern science view of all the appliances at the command of motion science and under the strong light cut by recent biological and techno-logical research, the inquiry which we propose assumes great importance. One phase of it is belog attentively and vya tematically regarded in the great experiment stations, another phase is being studied in the laborations of disensity and pharmacy, while still another presents held in the unseems of conomic botune;

Our question may be put in other words, which are even more practical. What present likelihood is there that our tables may, one of these days, have other vegetables, fruits, and cereals, than those which we use now? What chance is there that new fibres may supplement or even replace those which we spin and weave, that woven fabrics may take on new vegetable colours. that flowers and leaves may yield new perfumes and flavours? What probability is there that new remedial agents may be found among plants neglected or new wholly unknown? The answer which I shall attempt is not in the nature of a prophecy, it can claim no rank higher than that of a reasonable conjecture

At the outset it must be said that synthetic chemistry has made and is making some exceedingly short cuts across this field of research, giving us artificial dyes, odours, flavours, and medicinal substances, of such excellence that it sometimes seems as if before long the old fishioned chemical processes in the there is no telling where the trumphs of chemical synthesis will there is no telling where the trimiphs of chemical synthesis will end, it is not probable that it will ever interfere essentially with certain classes of economic plants. It is impossible to conceive of a synthetic fibre or a synthetic fruit. Chemistry gives us fruit ethers and fruit acids, and after a while may progress us fruit ethers and vide us with a true artificial sugar and amorphous starch, but attificial fruits worth the eating or artificial fibres worth the spinning are not coming in our day

Spinning are not common and comments of synthetic chemistry. The synthetic between the content to accept, for a long time to come, the results of the intelligent labour of the cultivator of the cold and the explorer of the forest. Improvement of the good plants we now utilize, and the discovery of new ones, unit romain the core of large numbers of diffigurent students, and associations workned Su that, in fact, our question residies shirtly into the Can these controls are the controls of the control of the controls of the controls of the controls of the control of the controls of the controls of the control of the contro practical investigators hope to make any substantial advance? practical investigators nope to make any substitutial advance? It seems clear that, except in modern times, useful plants law leen selected almost wholly by chance, and it may well be said that a selection by accident is no selection at all. Nowadays, the new selections are based on analogy. One of the most syring illustrations of the modern method is afforded by the utilization of bamboo fibre for electric lamps

utilization of bamboo fibre for electric lamps. Some of the classes of useful plants must be passed by without pre-ent discussion, others alluded to slightly, while still other groups fairly representative of selection and improvement will be more fully described. In this latter class would naturally come, of course, the foo! plants known as

I THE CEREALS

Let us look first at these the species of grasses which yield these seed like fruits, or as we might call them for our purpose seeds, are numerous, twenty of them are cultivated largely in the Old World, but only six of them are likely to be very familiar to you—namely, wheat, rice, barley, oats, rye, and mare. The last of these is of American origin, despite doubts which have been east upon it It was not known in the Old World until after the discovery of It was not known in the Old World until after the discovery of the New It has prohably been very long in cultivation. The olders all belong to the Old World. Wheat and larley have been cultivated from the earliest times, according to Pc Candolle, the chief authority in these matters, about four thousand years. Later came yea and oas, both of which have been known in cultivation for at least two thousand years ocen shown in cuttivation for at reast two thousant years. Even the shorter of these periods gives time enough for wid-variation, and as is to be expected there are numerous varieties of them all. For instance, Vilmorin, in 1886, figured wasty inv variaties of wheat with plantly distinguishable characters of the Chance records are to be tristed, rice has been cut-

valed for a period much longer than that assigned by our history valed for a period much longer than that assigned by our history and traditions to the other cereals, and the varieties are correspondingly numerous. It is said that in Japan above three handred varieties are grown on irrigated lands, and more than one hundred on uplants.

With the possible exception of rice, not one of the species of

cereals is certainly known in the wild state

It is out of our power to predict how much time would clapse before satisfactory substitutes for our cereals could be elapse before satisfactory substitutes for our cereals could be found. In the improvement of the grains of grasses other than those which have been very long under cultivation, experiments have been few, scattered, and indective. Therefore we are as budly off for time sutors as ere the goologists and archeologists on their statements of elapsed periods. It is impossible for us to ignore the fact that there appear to be occasions in the life of a species when it seems to be peculiarly susceptible to the anduences of surroundings. A species, like a carefully laden and property in the seems of forces within and without Disturbance may come through variation from within, as from a shifting of the cargo, or in some cases from without. We may suppose both forces to be active in producing variation, may suppose outs forces to be active in producing variation, a change in the internal condition rendering the plant more susceptible to any change in its surroundings. Under the influence of any marked disturbance, a state of unstable equilibrium may be brought about, at which times the species as such

brium may be frought about, at which times the species as such sead upon by very high agencies as sea so consequent of cross breeding within the extreme limits of varieties. The resilization from its such cases on persist only by close breeding or by propagation from bank or the equivalents of bads. The remainst form in such cases on persist only by close breeding or by propagation from bank or the equivalents of bads. The manuter, groung a sport of various kinds. These critical periods, however, are not unwelcome, since skillal calitations can take propagation of the state of the st

done. Bat we must confess that it would be absolutely un-ossible to predict with certainty how long or how short would be the time before new cereals or acceptable equivalents for them would be provided. Upsteld by the confidence which I shave in the intelligence, ingentily, and energy of our experi-nance of the confidence of the confidence which I have in the intelligence, ingentily, and energy of our experi-anced that of two generations of our race, or half a century. In now laying saide our hypothetical illustration, I venture to alk why it is that our experiment stations, and other institutions dealing with plants and their improvement, do not undertake unretigations like those which I have sketched? Why are not reference to their adoption as food grains? One of these species will naturally suggest tieff to you all—namely, the widt rice of reference to their adoption as food grains ⁵ One of these species will naturally asagest itself to you all—namely, the wild rice of the lakes. Observations have shown that, were it not for the their control of the control of the

lines of least resistance, and are dusniclined to make a fresh start. It is merely leaving well enough alone, and so far as the cereals are concerned it is indeed well enough. The generous grains of modern in ceites of wheat and hearty compensation of the control of the contr

From the cereals we may turn to the interesting groups of plants comprised under the general term

II VEGETABLES.

Under this term it will be convenient for us to include all plants which are employed for culturary purposes, or for table use, such as salads and relishes.

The potato and sweet potato, the pumpkin and squash, the red or capsicum peppers, and the tomato, are of American

origin
All the others are, most probably, natives of the Old World.
Only one plant coming in this class has been derived from
Southern Australasia—namely, New Zealand spinach (Tetra-Among the vegetables and salad-plants longest in cultivation we may enumerate the following turnip, onion, cabbage, purslane, the large bean (Faba), chick-pea, lentil, and one species of pea (garden-pea). To these an antiquity of at least

4000 years is ascribed Next to these, in point of age, come the radish, carrot, beet, garlic, garden-cress, and celery, lettuce, asparagus, and the leek. Three or four leguminous seeds are to be placed in the same category, as are also the black peppers.

Of more recent introduction the most prominent are the parsnip, oyster-plant, parsley, artichoke, endive, and splnach.

From these lats I have purposely omitted a few which belong exclusively to the tropics, such as certain yams. The number of wareties of these vegetables is attounding. The number of wareties of these vegetables is attounding and the second of the second twenty, earrot more than thirty; beet, radish, and potato, more than forty. lettuce and onion more than fifty: turnip more than seventy, eabbage, kidney-bean, and garden pea,

The amount of horticultural work which these numbers represent is enormous. Each variety established as a race (that is, a variety which comes true to seed) has been evolved by the same sort of patient care and waiting which we have seen is necessary in the case of cereals, but the time of waiting

has not been as a general thing so long.

In the case of the cabbage there are important morphological changes like those to which Prof. Bailey has called attention in the case of the tomato Suppose we are strolling along the neach at some of the seasing resorts of trance, and anothe hall in with this coarse cruciferous plant, with its sprawling leaves and strong odour. Would there be anything in its appearance to lead us to search for its hidden merit as a food-plant? What could we see in it which would give it a preference over a score could we see in it which would give it a preference over a score of other plants at our feet? Again, suppose we are journeying in the high lands of Peru, and should meet with a strong-timeling plant of the nightshade family, bearing a small irregular fruit, of sub-acid taste and of peculiar flayour We will further fruit, of sub-acid taste and of peculiar navour we will surner magnic that the peculiar tastes strikes our fancey, and we conceive that the plant has possibilities as a source of food. We should be led by our knowledge of the potato, probably a nature of the same region, to think that this allied plant might be safely trans ferred to a nothern climate, but would there be promise of ferred to a northern climate, but would there be promise of enough future usefulnes, in such as case as this, to warrant our carrying the plant north as an article of food? Suppose, climber, we should secretain that the fruit in question was found awarrant our considerable and an article of the secretary and found favour among the tribes of South Mexico and Central America, and had been cultivated by them until that attained a large sare, should we be stronglened in our venture? Let the introduction of the plant, and having urged everybody to try it, we should find it discarded as a fruit, but taking a place in gardens as a consisty under an abard name, or as a basis for preserves and pickles, should we not look upon our experiment.

in the introduction of this new plant as a failure? This is not a hypothetical case plant in question, was cultivated in Europe, as long ago as 155¢; it was known in Virginia in 1785 and in the Northern States in 1785; but it found it way into favour slowly, even in this land of its origin. A credible witness eat or even tate of the fruit. And Yet, as you are well aware, eat or even tate of the fruit. And Yet, as you are well aware, are present cultivation on an enormous scale in Europe and this country is scarrely sufficient to met the increasing defeated.

country is carriery suincent to meet the increasing demand.

Before asking specifically in what direction we shall look for new vegetables. I must be pardoned for calling attention, in passing, to a very few of the many which are laredy in limited use in Europe and this country, but which ment a wider em-ployment Cardon, or eardoon; celeracy, or turnip-rooted celery; fettucus, or corn-alaid; martynia; salsify; sea-klaic; and numerous small alaids, are examples of neglected treasures.

of the vegetable garden.

The following, which are even less known, may be mentioned

Ine tollowing, wants are even to be a superior of the safety promising:—

(i) Aracaca exculenta, called Arracacha, belonging to the pariley family. It is extensively cultivated in some of the northern States of South America. The stems are swollen near

the hase, and produce tuberous enlargements filled with an ex-cellent starch. Although the plant is of comparatively easy cultivation, efforts to introduce it into Europe have not been successful, but it is said to have found favour in both the Indice,

and may prove useful in our Southern States.

(2) Ullucus or Ollucus, another tuberous-rooted plant from (2) Ouscuts or Outcome, another tuberous-roote man town nearly the same region, but belonging to the beet or spinach family. It has produced tubers of good size in England, but they are too waxy in consistence to dispute the place of the better tubers of the potato. The plant is worth investigating for our hot dry lands

for our bot dry lands'
(3) A table bearing relative of our common hedge settle, or
(3) A table bearing relative of our common hedge settle, or
France, for the Parts market. Its name in Parts is taken from
the locality where it is now grown for use. Although its native
country is Japan, it is called by some seedsmen Chrises art
and are rather beard to keep, but it is thought "that both of
these defects can be overcome or evaded." Experiments indsee that we shave in this species a wilsuble addition to our

We must next look at certain other neglected possibilities Dr Edward Palmer, whose energy as a collector and neuteness as an observer are known to you all, has brought together very interesting facts relative to the food-plants of our North American aborigines. Among the plants described by him there are a few which merit careful investigation. Against all of them, however, there he the objections mentioned before,

(1) The long time required for their improvement, and
(2) The difficulty of making them acceptable to the community,

volving
(3) The risk of total and mortifying failure
In 1844 the late Prof. Gray called attention to the remarkable relations which exist between the plants of Japan and those of our eastern coast. You will remember that he not only proved that the plants of the two regions had a common origin, but also emphasized the fact that many species of the two conntries are almost identical. It is to that country which has yielded us so many useful and heautiful plants that we turn for new vegetables to supplement our present food resources. One of these plants—namely, Stachys—has already been mentioned as promising There are others which are worth examination and perhaps

There are others which are worm assumes acquaration.

One of the most convenient places for a preisiminary extension of the vegetables of Japan is at the railroad nations on the longer lines—some there are prepared lanches on the longer three places are prepared lanches on boxes of two or three stories, provided with the simple and yet embarrassing chopsuicks. It is worth the shock at causes one's nerves to neven in these boxes and try the vegetable contents. The bits of fish, fissh, and fowl which one finds therein can be expected and discarded, upon which there will remain a few delicates. The personal proton of boiled rice is of excellent means. The generation portion of boiled rice is of excellent means. separated and discarred, upon water the set is that of aromatic vinegar. The pervading older of the box is that of aromatic vinegar. The generous portion of boiled ree is of excellent quality, with every gram well softened and distinct, and this without anything else would suffice for a total three were undifferent to the control of t boxes which have fallen under my observation there were sundry boiled roots, shoots, and seeds which were not recognizable by me in their cooked form Prof Georgeson, formerly of Jacoquarable by me in their cooked form Prof Georgeson, formerly of Jacoquarable by the cooking of the cooking of

greens of various kinds, dried cucumbers, and several kinds of seaweeds. Some of the leaves and roots are cooked in much the same manner as beet-roots and beet-leaves are by us, and the general effect in our unspeptings. The bouled shoots are suggestive of only the tougher ends of asparagns. On the whole, I do not look back on Japanese railway luncheous with any longing which would compel me to advocate the indiscriminate introduction of the constituent vegetables here.

But when the same vegetables are served in native finas, under more favourable culturary conditions, without the flavour of vinegar and of the pine wood of the lunchoon boxes, they appear to be worthy of a trial in our horticulture, and I therefore deal with one or two in greater detail.

Prof. Georgeson, whose advantages for acquiring a knowledge

of the useful plants of Japan have been unusually good, has placed me under great obligations by communicating certain facts regarding some of the more promising plants of Japan which are not now used here. It should be said that several of these plants have already attracted the notice of the Agricultural Department in this country

The soy hean (Glycine hispida) This species is known here to some extent, but we do not have the early and hest varieties. These beans replace meat in the diet of the common

people.
Mucuna (Mucuna capitala) and dolichos (Dolichos cultra-

tus) are pole beans possessing ment Diorectes There are several varieties with nalatable roots.

Posteria There are several varieties with passessing one of these was spoken of by the late Dr. Gray as possessing "excellent roots, if one could only dig them."

Colocaria antiquorum has tuberous roots, which are nutri

Conophallus Konjal has a large hulbous root, which is sliced, dried, and heaten to a powder. It is an incredient in Araha cordata is cultivated for the shoots, and used as we use

paragus. *Œnanthe stolonsfera* and *Cryptotanya canadensis* are palatable salad plants, the former being used also as greens.

III. FRUITS.

Botamcally speaking, the cereal grains of which we have spoken are true fruits—that is to say, are ripened ovanes, but for all practical purposes they may be regarded as seeds The fruits of which mention is now to be made are those com-

First of all, attention must be called to the extraordinary changes in the commercial relations of fruits by two direct

causes—
(1) The canning industry, and
(2) Swift transportation by steamers and railroads
The effects of these two agencies are too well known to
require more than this passing mention. By them the fruits require more than this passing mention. By them the fruits of the best fruit-growing countries are carried to distant lands in quantities which surprise all who see the statistics for the missance, the figures given by Mr. D. Morris, at the time of the great Colonia and Indian Exhibition in London. Compare double decades of pers—

In the Colonial Exhibition at London, in 1886, fruits from the remote colonies were exhibited under conditions which proved that, before long, it may be possible to place such deheacies as the cherimoyer, the sweet-cup, sweet-sop, ramdeheacies as the chemnoyer, the sweet-cup, sweet-sop, ram-buta, mange, and mangosteers, at even our most northern buta, mange, and mangosteers, at even our most northern crease in our knowledge with regard to the microbes which produce decay, we may be able to protect the delease fruits from injury for any reasonable period. Methods which will supplement refrigeration are sure to come in the very near suppresent refregation are sure to come in the formation and future, so that even in a country so vast as our own, the most perishable fruits will be transported through its length and breadth without harm

The canning industry and swift transportation are likely to diminish zeal in searching for new fruits, since, as we have seen in the case of the cereals, we are prone to move in lines of least resutance, and leave well enough alone

To what extent are our present fronts likely to be improved? Even those who have watched the improvement in the quality of some of our fruits, like oranges, can hardly realize how

of some of our frust, like oranges, can hardly realize how great has been the improvement within hattoric times in the chimeter of certain peans, against the continue of the part of the continue of the question. In the runs of the lake-dwellings of the continue of the c

In comparing the earlier descriptions of fruits with modern accounts, it is well to remember that the high standards by which fruits are now judged are of recent establish nent Fruits which would once have been esteemed excellent would to-day

which would once have been esterned excellent would to-day. It seems probable that the list of seedless frints will be materially lengthened, provided our experimental horiculturalist make use of the material at their command. The common apple, and certain oranges. Others mentioned by Mr Darwin as well known are the bread fruit, pomegnanie, arnaole or Neapoltan media; and date palms. In commenting upon these fruit, Mr, Darwin says that most horiculturatis "look at the great's use and anomalous development of the first as the cause, and sternity as the result," has the holds the opposite commentation of the commentation view as more probable—that is, that the steraity, coming about gradually, leaves free for other growth the aboundant supply of building material which the forming seed would otherwise have the admits, however, that "there is an antagonism between the two forms of reproduction, by seeds and by bads, when either is carried to an extreme degree, which is independent of any

incipient sterility."

Most plant-hybrids are relatively infertile, but by no mean wholly sterile With this sterlity there is generally augmented vegetative vigour, as shown by Nageli Partial or complete sterlity, and corresponding luxuriance of root, stem, leaves, and flower may come about in other obscure ways, and such cases are familiar to botanists. Now, it seems highly probable that, either by hybridizing directed to this special end, or by that, either by hymnianing an according this tendency to the correlated changes, we may succeed in obtaining important additions to our seedless or nearly seedless plants. Whether the ultimate lated changes, we may succeed, in obtaining important additions to our seedless or nearly seedless plants. Whether the ultimate profit would be large enough to pay for the time and labour involved is a question which we need not enter into, there appears to me no reaxonable doubt that such efforts would be appears to the no reason in the nature of things why we ahould not have strawberries without the so called seeds, blackberries and raspherries, with only delicious pulp, and large grapes as free from seeds as the small ones which we call "eurrants," but which are really grapes from Corinth.

"eurrants," but which are really grapes from Corinth.

These, and the coreless apples and pears of the future, the stoneless cherries and plums, like the common fruits beforestoneless cherries and pluins, like the co-minn truits netore-mentioned, must he propagated by bud division, and be open to the tendency to diminished strength said to be the con-sequence of continued had propagation. But this livridge need not be crossed until we come to it. Bananas have been perpetuated in this way for many centuries, and pineapples since the discovery of America, so that the borrowed trouble alluded

to is not threatening.

It is absolutely necessary to recollect that, in most cases, variations are slight. Dr. Masters and Mr. Darwin have called attention to this, and have adduced many illustrations, all of which show the necessity of extreme patience and caution general student curious in such matters can have hardly any task more instructive than the detection of the variations in such common plants as the blueberry, the wild cherry, or the like It is an excellent preparation for a practical study of the variations in our wild fruits suitable for selection

It was held by the late Dr Gray that the variations in nature by which species have been evolved were led along useful lines

—a view which Mr Darwin regretted he could not entertain However this may be, all acknowledge that, by the hand of the cultivator, variations can be led along useful lines, and, furthermore, the hand which selects must uphold them in their unequal strife. In other words, it is one thing to select a variety, and another to assist it in maintaining its hold upon evisience. Without the comitant help of the cultivator who selects the useful variety, there comes a reversion to the ordinary specific type

which is fitted to cope with its surroundings

I think you can agree with me that the prospect for new
fruits and for improvements in our established favourities is fairly good.

IV PINTERS AND CARINET WOODS

Can we look for new timbers and cabinet woods? Comparatively few of those in common use are of recent introduction. Attempts have been made to hring into great prominence some of the excellent trees of India and Australia which furnish wood of much beauty and timber of the best quality. A large pro-portion of all the timbers of the South Seas are characterized by remarkable firmness of texture and high specific gravity

same is noticed in many of the woods of the Indies
the heavier and denser sorts, like Jairah, of West Australia,
and Sabicu of the Caribbean Islands, have met with deserved
favour in England, but the cost of transportation millitate against them It is a fair question whether, in certain parts of our country, these trees, and others which can be utilized for our country, these trees, and others which can be utilized for veneers, may not be cultivated to advantage. Attention should be again called to the fact that many plants succeed far better in localities which are remote from their origin, but where they find conditions substantially like those which they have left, This fact, to which we must again refer in detail with regard to This fact, to which we must again refer in detail with regard to certain other classes of plants, may have some bearing upon the introduction of new timber trees. Certain drawhiseks exist hard-wood trees which have prevented their taking a high place in the scale of values in mechanical engineering. One of the most useful softwooded trees in the world is the

Kauri It is restricted in its range to a comparatively small area in the North Island of New Zealand It is now being cut down with a recklessness which is as produgal and shameful as that which has marked our own treatment of forests here. It should which has marked our own treatment of foreign free; it atout to be said, however, that this destruction is under protest; in spite of which it would seem to be a question of only a few years when the great Kauii groves of New Zealand will be a thing of the past. Our energetic Fored Department has on its hands

of the pass
problems just like this which perplexes one of the new lands of
the South The task in both cases is double to preserve the There is no department of economic botany more promising

in immediate results than that of arboriculture

V VEGETABLE FIBRES

The vegetable fibres known to commerce are either plant hairs, of which we take cotton as the type, or filaments of bast trissie, represented by flax No new plant hairs have been suggested which can compete in any way for spinning with those yelded by the species of Gossypium, or cotton, but experiments more or less systematic and thorough are being carried on with regard to the improvement of the varieties of the species Plant hairs for the stuffing of cushious and pillows need not be referred to in connection with this subject
Countless sorts of plants have been suggested as sources of

good bast fibres for spinning and for cordage, and many of these make capital subtitutes for those already in the factories. But the questions of cheapness of production, and of subsequent preparation for use, have thus far militated against success. There may be much difference between the profits promised by a laboratory experiment and those resulting from the same pro-cess conducted on a commercial scale. The existence of such

differences has been the rock on which many enterprises seeking to introduce new fibres have been wrecked

In dismissing this portion of our subject it may be said that a process for separating fine fibres from undesirable structural ele-ments and from resin-like substances which accompany them is a great desideratum. If this were supplied, many new species would assume great prominence at once

VI TANNING MATERIALS.

What new tanning materials can be confidently ought for? In his "U-full Nature Plants of American," Mr. Maden about half as many eucalyter, which have been examined for the amount of tanning material contained in the bark. In all, eighty sever Autralian apecies have been under examination Brailer thin, much has been done looking in the same direction of the most and another the detection of Planton on Meeller, at the suggestion and smooth the detection of Planton on Meeller, at the suggestion and under the direction of Baron von Auseier, of Victoria This serves to indicate how great is the interest in this subject, and how wide is the field in our own country for the introduction of new teaming plants.

It seems highly probable, however, that artificial tanning substances will at no distant day replace the crude matters now

employed

VII RESINS, &c.

Resins, oils, gums, and medicines from the vegetable kingdom Keuns, oils, gums, and medicines from the vegetable kingdom would next engage our attention if they did not seem rather too technical for this occasion, and to possess an interest on the whole somewhat too limited. But an allied substance may serve to represent this class of products and indicate the drift of present research

India Rubber - Under this term are included numerous sub-

stances which possess a physical and chemical resemblance to eich other. An Indian Freus, the early source of supply, soon became inadequate to furnish the quantity used in the aris even when the manipulation of rubher was almost unknown. Liter supplies came from Meroe of Brain, generally known as Pian rubber, and from Castifos, sometimes called Central American rubber, and one Manish of Menanis, Cenar rubber. Not only are these plants now successfully cultivated in experimental gardens in the tropics, but many other rubber-yielding species have been added to the list. The Landolphias are among the most promising of the whole these are the African rubbers Now in addition to these, which are the chief source of supply. we have Willughbera, from the Malayan Peninsula, Lemonotis, (hilocarpus, Alstonia, Forsteronia, and a species of a genus formerly known as Urostigma, but now united with Figure These names, which have little significance as they are here pro nounced in passing, are given now merely to impress upon our minds the fact that the sources of a single commercial article may be exceedingly diverse. Under these circumstances search is being made not only for the hest varieties of these species but for new species as well

There are few excursions in the tropics which possess greater interest to a botanist who cares for the industrial aspects of and at Singapore. At both these stations the experimental gardens lie at some distance from the great Cardens which the tourist is expected to visit, but the exertion well repays him for Under the almost vertical rays of the sun, are all discomfort here gathered the rubber-yielding plants from different countries, all growing under conditions favourable for decisions as to their telative value. At Buitcizorg a well equipped laboratory stands ready to answer practical questions as to quality and composition

of their products, and year by year the search extends
I mention this not as an isolated example of what is being I mention this, not as an isolated example of what is being accomplished in commercial botany, but as a fair illustration of the thoroughness with which the problems are being attacked it should be further stated that at the Garden in question assidious students of the subject are eagerly welcomed, and are provided with all needed appliances for carrying on technical, chemical, and pharmaceutical investigations. Therefore I am chemical, and pharmaceutical investigations. Therefore I am justified in supring that there is every reason for believing that in the very near future new sources of our most important products. will be opened up, and new areas placed under successful cultivation

CHITMATON At this point, attention must be called to a very modest and convenient liand-hook on the "Commercial Budany of the Ninchestal Centry," by Mr Jackson, of the Botanical Misseum attached to the Royal Gradens, Kee, which not only embodies a great amount of well arranged information relative to the new useful plants, but is, at the same time, a record of the exising state of things in all these departments of activity

VIII. FRAGRANT PLANTS

Another illustration of our subject might be drawn from a class of plants which repnys close study from a biological point of view—namely, those which yield perfumes In speaking of the future of our fragrant plants we must dis

tinguish between those of commercial value and those of purely horticultural interest. The former will be less and less cultivated in proportion as synthetic chemistry by its manufacture of per-fumes replaces the natural by the artificial products, for example, coumarin, vanillin, nerolin, heliotropin, and even oil of winter-

When, however, one has seen that the aromatic plants of Australia are almost free from attacks of insects and fungi, and Australia are atmost free from attacks of insects and fungi, and has learned to look on the impregnating substances in some cases as protective against predatory insects and small foes of all kinds, and in others as fungicidal, he is tempted to ask whether all the substances of marked odour which we find in certain groups

all the substances of marked ofour which we find in certain groups of plants may not play a similar roll.

It is a fact of great interest to the surgeon that in many plants there is associated with the fragrant principle a marked antiseptic or fungicidal quality; conspicuous examples of this are afforded by ancers of European, welding realization. Stream, welding by species of Eucalypius, yielding eucalyptol, Styraa, yielding styrone, Thymus, yielding thymol It is interesting to note, too, that some of these most modern antiseptics were important constituents in the balsamic vulneraries of the earliest surgery Florists' plants and the floral fashions of the future constitute

an engaging subject, which we can touch only lightly. It is reasonably clear that while the old favourite species will hold

their ground in the gaire of improved varieties, the new introtheir ground in the gaire of improved varieties, the new mitro-ductions will come in the shape of plants with flowering branches are proposed to the proposed of the proposed plants and especially those in which the flowers precede the lenves. In short, the next real fashion in our gardens is probably to be the flowering shrub and flowering tree, like those which are such flowering the proposed plants are proposed to the country from which the Western would has cladly taken the gift of the chrysanthemum

Twice each year, of late, a reception has been held by the Emperor and Empress of Japan. The receptions are in autumn and in the spring. That in the autumn, popularly known as the Emperor's reception, has for its floral decorations the myrind forms of the national flower, the chrysanthemum, that which is given in spring, the Empress's reception, comes when the cherry bissions are at their best. One has little idea of the wealth of beauty in masses of flowering shrubs and trees, until he has seen the floral displays in the Imperial Gardens and the Femple. grounds in l'okio

CONCLUSION

Lack of time tenders it impossible to deal with the questions which attach themselves to our main question, especially as to which attach themselves to our main question, especially as to the limits of effect which cultivation may produce. We cannot touch the problem of inheritance of acquired peculiarities, or the manner in which cultivation predisposes the plant to innumer-able modifications. Two of these modifications may be mentioned in passing, because they serve to exemplify the practical character of our subject.

Cultivation brings about in plants very curious morphological changes. For example, in the case of a well known vere table the number of metamorphosed type leaves forming the ovary is two, and yet under cultivation the number increases irregularly until the full number of units in the type of the flower is reached Prof Bailey, of Cornell, has called attention to some further interesting changes in the tomato, but the one mentioned suffices to illustrate the direction of variation which plants under suffices to illustrate the direction of variation which plants under cultivation are given to take. Mostiventures are very at to occur equivalent to the control of the con

We have now arrived at the most practical question of all. namely-In what way can the range of commercial botany be extended?

In what minner, or by what means, can the introduction of new species be hastened? It is possible that some of you are aware of the great amount of uncoordinated work which has been done and is now in hand

in the direction of hringing in new plants The competition between the importers of new plants is so great both in the Old World and the New that a very large proportion of the species which would naturally commend themselves for the use of florists, for the adornment of greenliouses, or for commercial ends, have been at one time or another

brought before the public or are being accumulated in stock brought bufore the public or are being accumulated in stock. I he same as true, although to a less extent, with regard to useful as the same of the same of the same of the same of the as desirable for trail has not already been investigated as chemical, pharmaceutical, medical, horticultural, agricultural and trafe journals, especially those of high grade, contain a wealth of material of this character. But what is needed is they that the promising plants should the same of the But what is needed is they that the promising plants should

But what is needed in they that the promising plants should be systematically investigated under exhaustive conditions. It is not enough that an enthusiast kere, or an amateur there, should give a plant a trail under imperfactly understood conditions, and then report success or failure. The work should be thorough, and every question nonswerted tactgeorically, so that we might be placed in po-sevenon of all the facts relative to the object experimented upon. But such an undertaking require object experimented upon. But such an undertaking requires the co operation of many different agencies. I shall venture to cution some of these

mention some of these In the first place, Botanic Gardens amply endowed for research The Arnold Arboretum, the Shaw Garden, and the Washhigton Experimental Garden, are American illustrations of what is needed for this purpose. University gardens have their place in instruction, but cannot wisely undertake this kind of work.

In the second place, Museums and Laboratories of Zo-nomic Botary. Much good work in this direction has been department in charge of the investigation of new plants. We need institutions like those at Kew in England, and at Bulerancer in Java, which keep in close touch with all the nitude commensurate with the greatness and needs of our country is an undertaking which wait for some one of our

In the third place, Experiment Stations. These may, within the proper limits of their sphere of action, extend the study of plants beyond the established varieties to the species. study of plants beyond the established varieties to the species, and beyond the species to equivalent species in other genera. It is a matter of regret that so much of the energy displayed in these stations in this country, and we may say abroad, has not been more economically directed.

Great economy of energy must result from the recent change by which co-ordination of action is assured. The influence which the sintions must exert on the welfare of our country and

the development of 118 resources 18 incalculable In the last place, but by no means least, the co-operation of all who are interested in scientific matters, through their obser-vation of isolated and associated phenomena connected with plants of supposed utility, and by the cultivation of such plants by private individuals, unconnected with any State, Governmental, or academic institutions

By these agencies, wisely directed and energetically employed, the domains of commercial and industrial botany will be en-arged. To some of the possible results in these domains. I have endeavoured to call your attention.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

PROF. BONNEY will begin a source of about sixty lectures on geology at University College, London, on Teseday, October 6, see an employed and the seed of the see an employed and the seed of the seed

Humphry, F R.S

Flumpary, F. R. 5.

LECTURES will be delivered in Gresham College, Basinghall
Street, E.C., on October 6, 7, 8, and 9, by Dr E, Symes
Thompson, Gresham Professor of Medicine, on influenza and sts resuits

results
SEVERAL series of lectures for which the Salop County
and her made arrangements have been begun. They are on SEVERAL series of lectures for which the Salop County Connoi has made arrangements have been begun. They are on chemistry, bottony, geology, agricultural chemistry, management of agriculture, and are being given in various parts of the county. Most of them are being delivered in connection with the Oxford University Extension Scheme.

SOCIETIES AND ACADEMIES. 🅕 PARIS

Academy of Sciences, September 21 -M. Duchartre in the chair. -Admiral Mouchez made some remarks on the second volume of the Paris Observatory Star Catalogue, presented to the Academy. The Catalogue contains stars between the right ascensions 6h. and 12h, and about 500,000 observations made at accessions on and 129, and about 500,000 observations made at Paris during like last fifty years have been utilized in its con-coloured tight which illuminates the retime of the other, by M. A. Chauveau From the experiments described it appears that the excitation of one retina by coloured light influences, not only the optic nerves of thus retina, but also those of the opposite only the optic nerves of thus retina, but also those of the opposite only the optic nerves of this retus, but also those of the opposite oids, so that the stater are able to awaken the sensation of the colour employed whilst the excited return only sees the complete of the colour employed whilst the excited return only sees the complete of the colour employed by the colour employed and streening the other, when the glass as taken away the white of the colour employed the colour employed and streening the other, when the glass as taken away the white of the colour employed and the colour employed the colour e

Observations of the asteroid discovered by Charlois on August 28, made with the could equation of Algiers Observatory, by M. F. Sy. Observations for position were made on August 31 and F. Sy. Observations for position were made on August 31 and September 7 —Observations of Wolf's comet (1884 e 11L) made September 7—Observations of Wolf's comet (1884; 7115, made with the could equational (c) often apteure of L'pout observatory, which was a considered to the country of the

BODUS, PAMPHLETS, and SERIALS RECEIVED.

Machanic for Enginee, Pys. 1, possale and States New J. B.

Lot (Macmitta)—Manual of the Science of Reighe. Prof. P. D.

College of Pamel of the Science of Reighe. Prof. P. D.

College of Reighe. Prof. P. D.

Throughest and Training of the Science of Reighe. Prof. P. D.

College of Reighe. Prof. P. D.

Throughest and Training of the Science of Reighe. Prof. P. D.

Throughest and Training of the Science of Reighe. Prof. P. D.

Throughest and Training of the Science of Reighe. Prof. P. D.

Through the Science of Reight. Prof. Prof. Prof. P. D.

Through the Science of Reight. Prof. Prof. P. D.

Through the Science of Reight. Prof. Prof. P. D.

Supplement No. 2, Vol. 1, Part. No. 1 (Calculated, Journal of Prof. Prof. Part. P. D.

Part. P. D.

Through the Science of Reight. Prof. P BOOKS, PAMPHLETS, and SERIALS RECEIVED.

CONTENTS.

The Bacteriological Examination of Water. By

PAGE

	Prof Percy F. Frankland, P.R S	513
	Epidemic Influenza By R Russell General Chemical Mineralogy, By G. T. P	516
ı	Our Book Shelf;-	•
	Meredith: "Bush Friends in Tasmania"	517
	Taylor "The Elementary Geometry of Comes."-	• .
	R. T Ville: "Les Engrais Chimiques" Letters to the Editor:—	517
	Ville: "Les Engrais Chimiques"	517
	The Bird-Collections in the Oxford University Museum.	
	-Dr P. L Sclater, F.R.S	518
	Variation and Natural SelectionDr. Alfred R.	-
	Wallace	518
	A Rare Phenomenon -Arthur Marshall; W. Tuck-	
	well; F C Levander	519
	Instruments in Just Intonation -Robt. A. Leh-	
	feldt	519
	Unusual Frost Phenomenon, (Illustrated.)-A. H.	
	White of Mosquitoes.—W. Mattieu	519
	The Destruction of MosquitoesW. Mattieu	
	Williams	519
١	A Tortoise inclosed in Ice F. H. Perry Coste	520
	The Souring of Birds - A C, Baines	520
:	Rain-making in Florida in the Fifties G. P	521
٠,	A Dog Story.—John Bell Some Notes on the Frankfort International Elec-	521
•	Some Notes on the Frankfort International Elec-	
	trical Exhibition. II. (Illustrated) By W. E. A	521
	The Giraffe and its Allies By R. L	524
	Photographic Magnitudes of Stars	526
•	Notes	527
	Infinence of Aberration upon Observations of Solar	
	Prominences	530
	New Asteroids	530
1	Some of the Posstbillties of Economic Botany. By	
	Prof. George Lincoln Goodale	530
	University and Educational Intelligence	536
1	Societies and Academies	536
ı	Books, Pamphists, and Serials Received	536
	•	

THURSDAY, OCTOBER 8, 1801.

THE ICE AGE IN NORTH AMERICA.

The Ice Age in North America, and its Bearings upon the Antiquity of Man By G Frederick Wright, D D, &c. With an Appendix on "The Probable Cause of Glaciation," by Warren Upham, F.G S A. With many new Maps and Illustrations. (London: Kegan Paul, Trench, Trubner, and Co, Limited, 1890)

SWITZERLAND has been called the playground of Europe The glacial epoch occupies a similar position in geology. Here the student, weared with the precision of palicentology or of mineralogy, may revel in dreams of omnipotent glaciers, wrap himself in ice sheets, throw mental somersaults, swallow self-contradictory arguments, and be as blind to unpleasant facts as was nelson at Copenhagen, when he put the telescope to his useless eye, and "spoke disrespectfully" of the signal of recall. To any sucrestic hioran of the progress of recall. To any sucrestic hioran of the progress of abone, since it is so rich in unsound inductions and unsable hypothesis.

Dr. Wright's book, however, is, on the whole, a favourable exception to this general rule Passages, no doubt, may be found here and there, to which exception might be taken—notably to his remarks on the subject of cirques, in which he regards with favour opinions which are hard to reconcile with expressions in other parts of the book, and rest largely on an erroneous statement and "as a rule... occupy positions where glaciers first and "as a rule... occupy positions where glaciers first by facts, very clearly and carefully described, so that we feel, even if occasionally not quite convinced, that his view is worthy of careful and respectful consideration.

But in the matter of ice the subject is long, and our space is brief It will be better to abstain from criticism of details and give a short outline of those parts of Dr. Wright's book which will be of most interest to readers on this side of the Atlantic. As he states in his preface, his work deals not only with the Ice Age in North America, but also with the whole subject of the Glacial Period. So in its earlier part a considerable space is allotted to glaciers in general and their characteristics; in its later, so the the effects of the Glacial Period. In the subject of the Glacial Period in other parts of the world, its cause, its date, and its relation to the history of man. These, however, we shall pass over, and confine ourselves to the section dealing with glacial action on the North American continent.

After a sketch of the existing glaciers on the Pacific coast, Dr. Wright gives the results of a study of the Mur glacier in latitude 56° 50′, by the side of which a small party, of which he was a member, camped out for a month. This glacier is about a mile wide where it comes down to the sea, terminating in rec cliffs 300 feet, and sometimes a little above 400 feet in height. The rise in-land is gradual—perhaps about 100 feet per mile—and the main body of the glacier occupies a wast amphilithease, with diameters ranging from 30 to 40 miles. From a number of observations it appeared that the stream of ice entered the inlet, where the cross section

was about five milton square feet (5000 feet wide by 1000 deep), at an average rate of 40 feet a day (70 feet in the centre and to near the margin). It was, however, evident that this glacier, for some time past, had been reteating; indeed, fresh strations and dibbra could be traced to more than 2500 feet above its present surface. Dr Wright also found below the end of the ice the dead stumps of a forest of cedar trees, erect, and rooted in a clayey soil, but buried beneath glacial gravel. Probably this was deposited by streams, flowing from the advancing ice, wifich afterwards overrode the mass.

Dr. Wright estimates the amount of sediment which is now being washed down from the basin of the Muir Glacier as equal to nearly one-third of an inch per annum over the total area (1200 square miles) which it occupies. In regard to the vexed question of the excavatory powers of glaciers, Dr Wright expresses himself, as a rule, cautiously, ascribing to them the formation of true rockbasins under favourable circumstances, but laving stress upon the fact that, in the lower part of their course, where they are beginning to spread out over the lowlands, they can pass, as in the case mentioned above, over quite incoherent materials, without disturbing them. It also seems to follow from his remarks that he regards glaciers as agents of abrasion rather than of erosion, in which we have no doubt he is correct. As another indication of his general caution and candour, we may note that he is careful to point out that striated stones and rock surfaces do not always prove the former presence of a glacier, and may not even have been produced by the action of ice.

A large part of the book is devoted, as a matter of course, to a description of the glaciated area in North America. The boundary of this, as Dr Wright explains. is sometimes distinctly marked by a terminal morains, at others it is less definite, being only vaguely indicated by scattered dibris. But in his opinion-and here he expresses the opinion of the majority of American geologists-there was a time when a large part of Northern America east of the Rocky Mountains was buried beneath a mass of ice. There is, indeed, a driftless area in Wisconsin, which may have formed a kind of jardin on a gigantic scale, in this huge mer de glace, but, speakmg generally, the whole region of the great lakes was covered by an ice-sheet which came down to the sea at Long Island and traversed the northern part of Pennsylvania; thence its irregular frontal margin can be traced to the south-west, until, in the valley of the Mississippi, it reaches almost as far south as the 37th parallel of latitude. Of the various indications of this vanished ice-sheet, the smoothed and striated surfaces of rock, the moraines and boulder clays, the "kames" and "drumlins," Dr. Wright gives careful descriptions and illustrations, usually taken from photographs, so that the evidence is presented as clearly as is possible to the reader. To the last-named phenomena-the "kames" and "drumlins"-and some curious hollows which he calls "kettle-holes," Dr. Wright devotes much attention. The first he regards as indicative of lines of drainage in the closing stage of the Ice Age; the second, as early taminal moraines, modified in shape by the subsequent passage of the ice over them, and so anterior in date to the kames The kettle holes occur among moranic deposits, and are thus explained :- As the

ice is retreating, a mass of it may be insulated; as this melts, the superincumbent material tends to slip towards the edges, and thus to form a ring of debris, by which, after the ice has disappeared, a hollow is inclosed. Dr. Wright also adopts the opinion, maintained by Prof. Claypole, the late Prof. H. C. Lewis, and others, that one effect of the advance of this great mass of ice was to obstruct the flow of all rivers which take a northerly course, and thus to convert their valleys into lakes.

But into a discussion of this interesting question, and of the cause of the glacial epoch, to which a considerable space is devoted, we must not now enter. We must also pass over the questions relating to the date of the glacial epoch and its relation to the first appearance of men, merely stating that Dr. Wright inclines to regard the latter as pre-glacial, but the former as less remote than is generally supposed. It must suffice to say that he appears to be a careful observer, and generally a cautious reasoner, though slightly too prone to quote the remarks of others without due criticism , so that, on the whole, his book presents us with a good summary of the results of investigations into the glacial geology of North America, and will be valuable for purposes of reference on this side of the Atlantic. T G BONNEY.

THE TOTAL REFLECTOMETER AND THE REFRACTOMETER FOR CHEMISTS.

Das Totalreflectometer und das Refractometer fur Chemiker, ihre Verwendung in der Krystalloptik und zur Untersuchung der Lichtbrechung von Flussigkeiten. Von Dr. C. Pulfrich, Privatdocenten an der Universität Bonn, und Assistenten des physikalischen Instituts. With a Lithographic Plates and as Figures in the Text (Leipzig · W Engelmann, 1890)

"HIS book contains an exhaustive account of one of the latest devices in physical optics for investigating the refractive power of uniaxial and biaxial crystals. The idea of making use of the principle of total reflection for this purpose is not new Wollaston, at the beginning of the century, brought forward a method in which the crystal plate under examination was attached to a glass prism : but, owing to the experimental difficulties involved in this process, it met with little practical application, The instrument constructed by Kohlrausch in 1878, in which the crystal plate was immersed in a strongly refractive liquid, was a distinct advance, and has been much used. Within the last ten years, also, Wollaston's apparatus has been considerably improved by Fussner and Liebisch. Both these instruments, however, have still many inconveniences, and it is the claim of the author that the method which he has devised, and which forms the subject of the present work, is free from these,

To give some idea of this method, without entering into practical details, it will be sufficient to state that it consists essentially in the replacement of the prism of the Wollaston instrument by a glass cylinder, to the upper plane surface of which the crystal plate is attached. The cylinder can be rotated about its long axis, so that the refractive phenomena in all azimuths can be observed. This is the distinguishing feature which forms the chief advantage of

from the side at grazing incidence, and slowly rotating the cylinder, the whole extent of the limiting curves of total reflection comes under observation. By a special method of illumination from all sides the limiting curves may be received on a screen beneath the cylinder and made visible to a number of observers; e.g. in the case of a uniaxial crystal the appearance on the screen will be the sectional curves of the wave-surface, a circle and an ellipse corresponding to the ordinary and extraordinary rays.

The method was first suggested by the author four years ago. The object of the present work is to give a complete account of the series of measurements and observations which have been made with the instrument since that time with a view to testing its usefulness and trustworthiness After some preliminary observations on the theoretical principles involved in the method of total reflection, the author gives a detailed description of the construction of the new instrument and the methods of observation by which it is possible in a single crystal section to ascertain the position of the axes of elasticity, to measure the optic axlal angle for different colours, and to determine the principal refractive indices. Of special interest is the section on the appearances in the direction of the optic axes of biaxial crystals Observations made on a plate of asparagine, cut parallel to the optic axial plane, showed distinctly the effects due to the internal and external conical refraction, thus supplementing Lloyd's experiments in demonstrating the general correctness of the Fresnel wave-surface. The last section of the book deals with the refraction of liquids, and contains a description of the refractometer for chemists, which is a simplified form of the total reflectometer, in which a prism replaces the cylinder. Altogether, a perusal of the work leaves the impression that the invention of this ingenious and yet comparatively simple method for investigating the refractive power of doubly refractive media marks a decided advance in physical science, and the author appears to have quite substantiated his claim to have made the total reflection method, which has long been recognized as theoretically the most promising, also a thoroughly practical one. G, T, P.

A WEATHER RECORD OF THE FOURTEENTH CENTURY.

Consideraciones temperies pro 7 annis, per Magistrem Wilhelmum Merle, socium domus de Merton. Reproduced and Translated under the supervision of G. J. Symons, F R.S (London, Edward Stanford, 1801.)

N January 1337, barely forty-five years after the death of Roger Bacon, and ten years after the accession of King Edward the Third, William Merle, a Fellow of Merton College, and Rector of Driby, in Lincolnshire, commenced a journal of the current weather as expersenced partly at his rectory "in Lyndesay, near the north-east coast," and partly at Oxford. This journal he continued month by month for seven years, or up to three years before his death, the notices of the last four years being considerably amplified over the earlier entries; and the original manuscript, still preserved in the Bodthe new method. Thus, by illuminating the crystal plate | lean Library, has now, thanks to the initiation of Mr. G. J. Symons, been reproduced in factimile by photography, translated from the monkish Latin of the original text by Miss Parker, and published in a handsome small folio volume, of which one hundred copies have been printed. It is probably, as stated on the title-page, the earliest known weather journal in the world.

The manuscript consists of nine and a half pages of abbreviated Latin, written on vellum in a distinct and easily decipherable text, and is apparently in excellent preservation. It is bound up with a number of other manuscript treatises (one of which is also by Merle) dealing with weather prognostication, astrological lore, and other subjects which, according to the scientific views of the day, were nearly related branches of knowledge. Some of these treatises were collected, and some written by, William Reed, who was Bishop of Chichester from 1369 to 1386, and who bequeathed them to scholars of Merton, "being of his kin" Subsequently, the volume passed into the possession of Sir Kenclin Digby, who, in 1634, presented it, together with other manuscripts, to the Bodleian Library It is interesting and not uninstructive to note how modest a figure is cut, in this scientific record of the fourteenth century, by the few pages of original observation amid the mass of speculative writings in which they are buried, and how in the nineteenth century they alone retain all their pristine value, and are resuscitated with all the honours of facsimile reproduction, while the learned treatises on the conjunctions of the planets, the lunar mansions, and rules for prognosticating the weather, are left undisturbed in the musty dignity in which they have reposed for more than five centuries.

As already remarked, Merle's entries are at first very brief, the notice of each month's weather seldom exceeding two lines of the manuscript Thus for January 1337 we find :-

"In January there was warmth with moderate dryness, and in the previous winter for the previous part of the same winter?] there had not been any considerable cold or humidity, but more dryness and warmth "

Gradually, however, the notes expand, and it is not a little interesting to trace how by degrees the journalist's growing interest in his probably novel undertaking leads him to record more and more in detail the facts that present themselves to his daily observation. Thus from a brief general summary of the characteristic weather of the month, as illustrated in the above quotation, at the end of the year he proceeds to record the character of each week, and towards the end of the third year (1339) he begins to notice the weather of a few special days. From the beginning of 1340 greater amplification is indulged in : the monthly notes often expand to six or eight lines, and in the final year of the record (1343) sometimes to from ten to fourteen lines. In illustration of these more detailed entries, the notice for July 1343 may be

"July.—Considerable heat on the first five days, and it was great on the 3rd and 4th. On the 4th, two or three hours before sunset, heavy thunder began with more vivid lightning than I think I had ever seen, which lasted until mid-night, with heavy rain. 5th, light thunder about sunset. On the 6th day and throughout the second week it was

gloomy, and there was a slight fog occasionally. 12th, light rain, 14th, gloomy, 15th, and three following days, considerable heat, 19th, rain which penetrated a good deal: 20th, light rain, 22nd, rain: 25th, heavy rain, with deary thunder in the night, and also in the morning of the following day. All the remainder was rainy, with fog, and rain in small drops, and it was gloony the whole time, 28th in the night, and 29th in the morning, thunder, with heavy rain thunderstorms" There was lightning with the last two

For the last four years, indeed, Merle's notes are sufficiently ample to allow of a fair estimate of the weather of those years in comparison with that of the present day, and perhaps some such comparison may be instituted by those who have at command the ample registers of our own time for the same part of Lincolnshire Seeing how great have been the changes wrought in the character of the surface of the country, by the clearing of forests, dramage, and the extension of agriculture, such a comparison may possibly furnish matter of great interest

The fourteenth century is sadly memorable for the disastrous famines and pestilences that then desolated England, and above all for the "Black Death," which half depopulated the realm, and was nowhere more fatal than in East Anglia But this last did not make its first appearance until the end of 1348, about a year after Merle's death, and nearly five years after the conclusion of his journal, which ends abruptly with January 1344. and although a severe famine is recorded in 1335, and another in 1353, it does not appear that any of the years included in his register was especially disastrous. The famine of 1335 is said to have been due to excessive rain. and we may perhaps harard the surmise that the recent memory of this visitation was the stimulus that induced Merle to record these interesting notes, which good fortune has preserved for us through five and a half confuries

OUR BOOK SHELE.

The South Italian Volcanoes. Being the Account of an Excursion to them made by English and other Geologists in 1889, under the auspices of the Geologists' Association of London, with Papers on the Different Localities by Messrs Johnston-Lavis, Platania, Sambon, Zezi, and Madame Antonia Lavis, including the Bibliography of the Volcanic Districts, and Sixteen Plates. Edited by H J. Johnston-Lavis, M.D., F.G.S., &c. Pp. 342 (Naples: F. Furchheim, 1891.)

In this useful volume, Dr. Johnston-Lavis has issued reprints of his report on the Italian excursion made by the members of the Geologists' Association under his direction, and of his abridged sketch of the geology of Vesuvius and Monte Somma, already noticed in this journal. These reprints are accompanied by several journal. These reprints are accompanied by several interesting original papers—annely, one on the thermomeral and gas springs of Sujo, near Roccamonias, by Polyndamon. Laws himself; one on the geology of Acrashabe Polyndamon. Polyndamon and Polyndamon and Acque Abbule in the neighbourhood of Tivoli, *by Signor Pietro Carlon, *control of the Polyndamon and Acque Abbule in the neighbourhood of Tivoli, *by Signor Pietro Carlon, *control of Pietro Pietro (Pietro) and Acque Abbule in the neighbourhood of Tivoli, *by Signor Pietro (Pietro) and Pietro (Pietro) and Acque Abbule in the neighbourhood of Tivoli, *by Signor Pietro (Pietro) and Pietro (Pietro) and Acque Abbule in the neighbourhood of Tivoli, *by Signor Pietro (Pietro) and Pietro (Pietro) and Acque Abbule (Pietro) and Acque Abbule (Pietro) and Acque Abbule (Pietro) and Acque Abbule (Pietro) and Pietro) and Pietro (Pietro) and Pietro) and Pietro) and Pietro) and Pietro (Pietro) and Pietro) and Pietro) and Pietro (Pietro) and Pietro) and Pietro

well-selected points of view, and admirably reproduced as well-selected points of view, and admiratily reproducest as small quarto plates. These plates are striking illustrations of what can be accomplished by instantaneous photography as an aid to sulcanological study. Among them are very instructive views of explosive outbursts from the creaters of Stromboli and Vulcano. In the case of the small explosions from the first-mentioned volcano, the ejected fragments are seen in the midst of the steamclouds; and in the case of the more violent eruptions from Vulcano several phases in the same outburst have been know this very interesting district will be glad to have their recollections revived by these admirable plates; and those who have never had the pleasure of visiting the South Italian volcanoes may obtain from these remarkable photographs a much better idea of the localities than any descriptions or drawings can possibly give.

Buried Cities and Bible Countries. By George St. Clair, F.G.S. (London: Kegan Paul, Trench, Trubner, and Co. 1801)

EVERYONE knows that recent archæological research has brought to light a vast number of facts which are directly or indirectly connected with ancient Hebrew The object of the author of the present work is to set forth the more important of these facts, and to explain their significance. He deals with the results of explain their significance. He deais with me results or exploration in Egypt, Palestine, and Mesopotamia; and he has a chapter on Jerusalem, with legard to the topo-graphy of which he has been led to conclusions different from those of other writers. The book has been prepared for the benefit of persons "who have no time to follow the course of exploration, and no taste for technical details". and readers of this class will find in technical details", and readers of this class will find in it much that will be to them both new and interesting. The value of the text is increased by good maps, plans, and other illustrations

Food, Physiology, &c By William Durham, F.R.S.E. (London and Edinburgh A. and C. Black, 1891)

THIS is the third volume of a series by Mr Durham, entitled "Science in Plain Language." The author does entitled "Science in Plain Language." The author does not pretend to say anything new, but he has brought together, and arranged clearly, a mass of facts which will no doubt be of interest, and may be of practical service, to many readers who have neither time nor service, to the total property of the consideration of solid and liquid foods. then gives some account of the constituents of food, and finally sketches the structure and functions of the bodily organs.

Blackie's Science Readers (London: Blackie and Son.

THE aim of this series is to arouse the interest of children in the common objects of the natural world, and to give in the common objects of the processes by which articles of ordinary use are produced. The idea is excellent, and has been very successfully worked out. The series consists of five little volumes, the first two of which present some "lessons on common objects" From the third volume. the reader wiff learn something about the simple principles of classification; about substances used in arts and manufactures; about phenomena of earth and atmosphere; and about matter in three states—solids, liquids, and gases. The fourth and fifth volumes—by the Rev. Theodore Wood—deal with animal and plant life. The facts set forth have been carefully selected, and they are presented in a bright, easy, natural style which cannot fail to make them at once intelligible and attractive. Good teachers will find the series of real service in helping them to foster in the minds of their pupils a love of accurate observation and independent reasoning

NO. 1145, VOL. 44]

LETTERS TO THE EDITOR.

[The Editor dost not hold himself responsible for opinions ex-pressed by his correspondents. Neither can be undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.

Comparative Palatability

Wilst the view of supplementing the experiments carried out last year by Mr. F. Finn said myself (NATURE, vol. 3kii, pp. research of the common frequent of the description, research of the common frequent of the common frequent of the Markov (Markov). The common frequent of the Markov (Markov) is the control of a Inplantual Genous and workers, have recorded to J. Anjudersus (Genous and workers), and muscrasm (Grones and workers), from the common only a freely-frequent greg related to attack for one occasion only a freely-frequent greg related to attack for On one occasion only a freely-feeding frog refused to attack for the second time a large queen of ierretire, which had sting its mouth. Many of the insects were, however, thus taken at the second attempt. The common warp was eaten eagerly by frogs and toads. I was again unfortunate in not taking any Chrystades. Surver, grays was attacked both by a frog, for which it seemed to large, and by a toad, under whose lip it appeared to insert its ovipositor. Neither animal ventured to seize it again—certainly for an hour or so I was then obliged to abandon the observa-

composition. Nettner animal wentured to test it again—certainly composition. It could get not have sheen successful to a constraint of the control of the co

Blatta orientals: was taken without hesitation, as week, of course, earthword observation, only one was of much work-ing value. This specimes (a male) became in a fortinght to include the property of the property of the property of which I placed the insects, &c., in the inclosure. The fact re-calls Mr. E. B Poulton's observation, that his tree-frog seried the end of the forceps with which food was given them. It is, perhaps, worthy of arotice that the larve of the blow-fly, though eaten ergerly by toads, are frequently passed whole from the lody; and would, therefore, seem to be with difficulty

digested.

Want of time has prevented my experimenting, as I had wished to do, with Salamandra maculosa. Mr. F. Finn offered a specimen to ducks, which will eat the small newt, and found that though more than one bird observed it, and one even ran towards it, it was not touched. The observation extended over more than an hour.

Mote House, Mote Road, Maidstone, September 25.

Alum Solution.

isolément.

A cette occasion, je prendral la liberté de relever une érreur que l'on a fréquemment commise dans ces derniers temps au ujet de l'absorption des radiations infra-rouges par l'eau.

contume de définir le rendement d'un foyer de lumière par le rapport de l'écergie située dans la partie visible du spectre à l'énergie toitae royonnée par le foyer. Sans lassiere un ce que d'energie toitae royonnée par le foyer. Sans lassiere un ce que cette question dans la Révus fabriat des Stancars, per rappel ensi qu'on meure d'ordannée le rendement en recevant successivement sur un radiomètre qualconque (pile de Méllon, dobonitées, maiomicrometre de Boys) la radiatous totale du colomitées, maiomicrometre de Boys) la radiatous totale du condimient de la radiation obscures ont été retenees, et on fait le quotient de ce deux quantitée. Aumen physicars, pe suppose, ne crost que l'absorption par l'étu commence à l'éndroit précis ne crost que l'absorption par l'étu commence à l'éndroit précis propues en précise que le révisible ains oblem est sistem aprocédé

où cesse la vision, et devient Immédiatement totale, mais on pense en général que le résultas anno lobeme est asses approché Or nous pouvons déterminer directement le rendement photograque d'une souvere en meurant la superficié des courbes d'inegue avec souvere en meurant la superficié des courbes d'inegue avec pour cent d'inegue avec pour cent d'inegue avec pour cent Dautre part, les recherches de M. Knut Angatrom ont montré que l'absorption par l'ean ent preagen nulle pour à « 1, se, et n'est totale qu'à partir de A = 2, a caviron. Une couche épasses d'eau nisais passer prèse de 10 pour cent de l'énergie rayonnaite tendément d'une lampe à gaz, 11 à 12 pour cent, c'est à dire une quantité ut Kolterpo free une quantité six fols trop forte

une quantité six fois trop forte
je ne quitterin pas ce sujet sans faire tennaquer le singularest en érent duquel le sansance de la rédation solaire
est en érent duquel le sansance de la rédation solaire
possibles—cheval, horze, posser, vatt, ainsi que tostes les pursances
possibles—cheval, horze, posser, watt, ainsi que tostes les radiations—sont exprimées par rapport à la acconde
Il serait temps
de faire disparaitre cette anomalie.

CH. ED. GUILLAUME Pavillon de Breteuil, Sèvres, France. 25 septembre, 1801.

Weather Cycles.

Witti reference to this most lateresting question, may I be all owed to cell attention to the following figures? I living all owed to cell attention to the following figures? I living all owed to the following figures? I living figures in the control of the cell of the we had generally an unusual prevalence of dry weather, in autumn our usual wet weather returned." It may be remarked autumn our usual wet weather returned. A may be tolk that the interval of 23 years is about double the sun-spot period, and furthermore that the years mentioned by Rutty correspond roughly with years of sun-spot minima or maxima as given in Wolf's Catalogue, mentioned by Guillemin in his work "Le Ciel" (1877), p 104. This correspondence would appear as

1		Interval.
Interval	Great colds	Interval.
	1638	
20'5	1661	23
25	16°4	23
20 5	1708	24
12 5	1716	8
20 7		23
168		15 23
60)		8)
	20 5 12 5 20 7 16 8	20'5 1661 25 1661 20 5 1694 20 5 1708 12 5 1716 20 7 1739

Royal College of Science for Ireland, Stephen's Green, Dublin, September 35.

NO. 1145, VOL. 447

Occurrence of the Ringed Snake in the Sea.

THE readiness with which the British snake (Tropidonotus natrix) will enter fresh water is well known. Its occurrence in the sea seems anomalous, and therefore I venture to submit the following details.

tollowing details.

The specimen in question was seen on September 7, from a small boat on the east coast of the Isle of Wight, while about a thousand yards distant from the shore, and about midway between Shanklin and Luccombe Chines. When first seen it was swimming straight out to sea—viz in an easterly direction.

The sea was calm and a strong current was flowing from the south, so that the creature was swimming across the current.

At first it took no notice of the hoat, but as the boat was rowed towards it, it changed its course and swam directly away from the bas. It was foot experience, and found to be uniqued and most conductor. Upod discount of the uniqued and most conductor. Upod discount of the entire alimentary cand was absolutely empty. The internal 31 inches in length. It is most probable that this snake entered the sea shout a find from where twas obtained, as the beach is bounded by almost perpendicular cliffs, some 30 of eet high, at that place. the boat. It was soon captured, and found to be unnitured and

A Rare Phenomenon.

A Rare Phenomenon.

Me Wilson's letter is porsus use of September 24 (p. 994),
recalls what I myself saw on the same evening. On Friday, the
tilt, I was returning with a friend to town after a day's ramble
in Epping Forest. We easight the 8 36 pm train at Epping,
which is due at Woodford at 8 30, and was, I links, only a few
my frend and myself simultaneously noticed a luminous band,
as that observed by Mr. Wilson, and extending from the
horizon almost to the zenith. Our first unreflecting thought was
to refer it to the receiving light at the Naval Exhibition, only it
horizon almost to the zenith. Our first unreflecting thought was
to refer it to the receiving light at the Naval Exhibition, only it
hold to such that the serving light at the Naval Exhibition, only it
hold to be such a such as the serving light at the Saval Exhibition
to such a such as the serving light at the Saval Exhibition
to such a such as the such as the serving light at the serving the serving
that the point in the horizon from which the beam rose
was almost dieter the Oreat Bera, but a little to the left as
well as the serving the serving the serving the serving
the serving the serving the serving the serving the serving
the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the serving the s

Burlington House. Heunson Bry

THE narrow luminous band described in NAIURE, September 24 (p 496) was seen here on Friday, the 11th inst., between 8 you and 9 y.m., at the same time at which it was seen by Mr. Wilson in the country Westmeath, but about twenty-two hours later than it was seen by Prof. Copeland in Aberdeenshine. It passed close is such of Cassiopeia, and nearly through the resulth laif an hour; later it had drilled 8° or to 'couldward, and had become very faint.

become very faint.

There can be little doubt that the very rapidly moving "comet" seen by Mr. Eddie at Grahamstown, South Africa, on October 27, 1890, was a phenomenon of this kind

The Observatory, Armagh, September 36.

The Heights of Auroras.

The Heights of Auroras.

Tits rare part of the phenomena described by your correspondents is the extreme narrowness of the auroral strakes seen expensive the second of the property of the pr

culating the height of that. I made several observations of the position of the central line of the arch. I might specify that at 9 25 it was at R.A. 20h 42m., Decl. + 33½, and R.A. oh 43m., Decl. + 33½, and it moved very slowly.

Deci. + 33', and it moved very slowly.

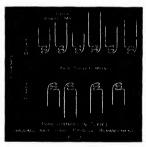
Is it not time some systematic effort was made to calculate
the heights of auroras? A good many observations have been
made on this point, showing great variation in height; and yes,
beyond the conclusion that it seems probable they may be seen at lower elevations nearer the magnetic pole than elsewhere, we know nothing as to whether they vary in height with the place, the time, or the nature of the auroras Now is the time, seeing that auroras appear to be becoming more numerous than they have been for many years past T W BACKHOUSE.

West Hendon Honse, Sunderland, October 5

SOME NOTES ON THE FRANKFORT INTER-NATIONAL ELECTRICAL EXHIBITION.

From One Hundred to Twenty Thousand Volts.

THE incandescent lamp having, by 1885, reached a fair degree of perfection, it appeared that the one need still remaining, in connection with the distribution of the electric light over a large area, would be supplied by the use of transformers. For a transformer with many convolutions of fine insulated wire on one coil, and a few convolutions of thick insulated wire on the other, would transform a large pressure and small current into a small transform a large pressure and small current into a small pressure and large current; hence, if such a transformer were placed in each house, it would be possible to light up even a scattered district by a comparatively fine wire from a central station, whereas previously it had seemed



that it would be necessary to use copper conductors many square inches in cross section to light many houses even when at no great distance from one another.

Hence, in the autumn of 1885 we find Messrs, Gaulard and Gibbs making preparations at the Grosvenor Gallery, Bond Street, for establishing there the pioneer central station for London

But the method they adopted was that of placing the transformers in series, as seen in Fig. 2, and this system has the great disadvantage that the brightness of the electric lamps in a house cannot be kept automatically constant when other lamps in the same house are turned

1 Continued from 1. 524.

on or off There are, of course, two conditions to be fulfilled in electric lighting. one, that turning on of lamps in one house shall not affect the brightness of the lamps in one nouse span not affect the original on or off lamps in one room shall not affect the brightness of the lamps in any other room of the same house. With trans-formers in series, the first condition is satisfied by keeping the alternating current which passes through the fine wire or primary cost of the transformer perfectly constant; but this does not render the potential difference between the wires from the secondary circuit, or house mains, independent of the current in this secondary circuit—that is, independent of the number of lamps turned on in the house. Conseof the number of names curred on in the house. Consequently, the series arrangement of transformers adopted by Messrs. Gaulard and Gibbs, while rendering the lamps in one house independent of those in another, did not attain the same result for lamps in different rooms of the same house

Complaints, therefore, became general. Various un-successful devices were tried to remedy this evil, when an application was received from Mr Sebastian Ziani de Ferranti to be allowed to try a transformer which he had designed The application was accepted, for Mr Ferranti, designed the application was accepted, for Mr Ferrant, although quite young, was already known as having constructed an ingenious alternate-current dynamo, and in February 1886 the charge of the Grosvenor Gallery central station passed over into Mr. Ferranti's hands

The new engineer recommended that the system of placing the transformers in series should be totally discarded, and that a parallel arrangement should be adopted



in its place, as in Fig. 3, because a well-made transformer had this important property -that if the potential differ-ence at the terminals of the primary coil were kept constant, the potential difference between the terminals of the secondary coil would also remain nearly constant whatever were the current passing through this circuit; so that if the pressure between the street mains were always kept the same, the brightness of the lamps would hardly be affected either by turning on or off lamps in the same or in any other house.

Placing the transformers in parallel, however, would necessitate working at a low pressure, said the press, and would rob the transformer system of all its value, for "it is surely not proposed for one moment to work a parallel is surely not proposed for one moment to work a parane-system where the primary has a difference of potential of 2000 volts." However, that is exactly what Mr Ferranti not only proposed to do, but what he actually carried out on a large scale, so that his mains by 1888 stretched from Regent's Park to the Thames, and from Chancery Lane to Hyde Park, supplying current to some 20,000 glow-lamps. The Board of Trade had made regulations, about 200 the Doard of Jrace had made regulations, mout 200 volts being the maximum pressure permitted in a house; Parliament had passed the Electric Lighting Act of 1882, containing clauses rendering the development of .be electric lighting industry well nigh commercially impossible; but Mr. Ferranti overcame all these legalities by bridging his mains from house-top to house-top, instead

of putting them under the streets and himself under the control of the authorities.

But every corner at the Bond Street central station had soon to be utilized; a dynamo weighing tons had on one occasion to be lifted into position over a steam-engine necessarily kept always running to maintain a

existing overhead mains, and again reduced to 100 volts

evisting overnead mains, and again reduced to 100 volls on entering the houses, as before.

The scheme was a far-reaching one; permission was saled from the Board of Trade by the London Electric Supply Corporation, the outcome of the original Grosenor Gallery Syndicate, to run wires along 27 railways

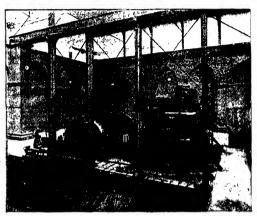


Fig. 4 -Two 1250 horse power dynamos (opened for inspection) at D-peford

constant supply of current to the houses. New customers constant supply of current to the noises. New customers were added daily to the list, more and more current had to be generated nightly, in the face of engineering difficulties, and in the teeth of injunctions against smoke, injunctions against noise. A fresh start became imperative, so it was decided to build at Deptford, 6 miles away from Bond Street, a vast

and through 30 parishes; two dynamos, each to furnish and noting to participate the state of the s



copper tube, a, outer copper tube, p, iron protecting in be, waxed paper insulation shaded black F10 5.-Longitudinal section of the Ferranti main

generating station, which should be the largest in the world, and to use the Grosveror Gallery, and probably fresh sites to be obtained in town, merely as transforming stations. In the mains between Deptited and London in twiss decided to employ 10,000 volts, to be reduced to 2,000 in London, and the power then distributed by the The inner, copper tubes, to 2 feet long seen in section, 4, the contraction of t

NO. 1145, VOL 44]

Fig. 5, has brown paper soaked in ozokerit rolled round it to a thickness of about five-eighths of an inch. Outside this is slipped a larger copper tube, B. Fig. 5, and the whole is drawn through a taper die under great pressure, which has the effect of forcibly compressing the paper and consolidating the mass. Next, more brown paper

544

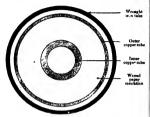


Fig 6 -Cross-section of the Ferranti main , full size

soaked in melted orokent is rolled on, to a thickness of one-eighth of an inch, and the whole slipped loosely into an iron tube, D, Fig. 5, which protects the cable subsequently from mechanical injury To fill up any spaces that may have been left between the iron and the outer copper tubes, the 20-feet section is placed over a

The object of using concentric tubes is wedded—first as the outer copper tube is been practically at the poster-tial of the earth, it is impossible to get a severe shock unless the inner tube is touched, and this, of courte, can only be done by first cutting through the outer; second, the effective increase of the resistance and of the self-induction which occurs with rapidly alternating curricular to the conductor on one another is much less for a given cross section of copper with concentre tubes than with two insulated rodes placed side by side. For example, Sir William Thomson has calculated that if copper be employed in the form of a solid rod, ourself, of a frequency of 80 per second will be 31 per cent, greater than for a steady current.

It is very questionable, however, whether these advantages of using concentructubes are not more than compensated for by the large electrostatic capacity that such a cable possesser. For, as is now fully recognised, the combination of capacity and self-anduction can by a species of resonance cause the difference of potential in the circuit to be far greater than the E.M.F. of the greater than the capacity and approach property of the capacity and in certain cases, very dangerously greater

greater soon as the Depford main was constructed to stand of cox volts, it was found that one of the dynamos seen in Fig. 4 broke down at this pressure, and therefore for many months the current was seen from Depford at only 5000 volts; next, the transformer room at the Grosvenor Gallery was burnt down through carelesaness, some £8000 worth of transformers destroyed, and a portion of London left in darkness for two or three weeks New transformers were healty, too hastily, constructed, and the last December; but after a few days the transformers





Fig. 7.—Ends of two pieces of main, tapered ready for jointing.

a, copper red to make electric connection between inner copper tubes; z, wared paper coded like a pencil

fire, and melted wax pumped in between the two through a tube inserted in a hole drilled in the middle of the iron

Fig. 6 shows a cross-section of the finished main full size, and as the sectional area of the metal in each of the copper tubes is about a quarter of a square inch, the main can transmit about 2000 horse-power at 10,000 volts. were, one after another, short-circuited by the electric current sparking from the primary coil to the iron core of the transformers, and all the houses on the London Electric Supply Corporation's system again left in darkness during the nearly perpetual night of a densely foggy winter. The Metropolitan Electric Supply Company which also distributes an alternating current by means of



F10 8.—Ferrants main, jointed r, copper alseve alloyed over, two ends of outer copper tubes, and then corrugated with special tool, o, iron sleeve slipped over, two ends of iron tubes, and corrugated with special tool, n, acrew-hole to run in malted wax, t.

The main being constructed in lengths of only 20 feet, some 1500 pions have had to be made in 6 miles of main, or 6500 joints altogether in the five mains which have been made without solder, in the way shown in Figs. 7 and 8, pressure alone between the copper tubes having been relied on to maintain good contact.

NQ. 1145, VOL. 44]

transformers, but from several central stations in the heart of London itself, and therefore requiring to use only 1000 volts and a single transformation—came to the recue in certam districts, but in others the householders had to be left to their fact, as it would have been far too expensive to run special mains from the Metropolitan Company's stations merely as a temporary expedient.

Finally, in March of this year, current was again turned on from Deptord, at the pressure originally gro-posed, vis. 10,000 volts. It was not, however, supplied from the dynamos illustrated in Fig. 4; bit, instead, Messra. Depret and Carpentier's plan of transforming p. 52a, was employed. For, by this time, two dynamos, formerly at the Grossenor Gallery, each of 600 horse-power, had been taken to Deptord and erected there, as seen in Fig. 9, new steam engines, more powerful than been constructed to drive them, overeor Gallery, having been constructed to drive them.

These dynamos generate the current at 2400 volts, then, by means of transformers at Deptford, this is raised to 10,000 volts. On the power arriving in London, the

London at a pressure which, even at the end of last year, was deemed simply visionary

mussion is a direct year in a control of the property and in a mission is a deray failure, and even that is the advantage of tansmitting the current 6 miles that is in any way commensurate with the capital already expended? When power can be obtained very cheaply, from a rapid river for example, it may be highly remunerative to transport it in some such way as is now being done between Lauffen and Prankfort But can power be obtained so be a control of the control of

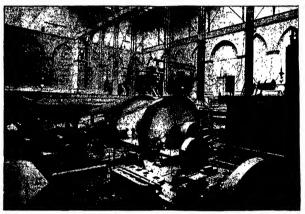


Fig. 9.—Two of the Grosvenor Gallery dynamos re erected at Deptford and driven by new steam angines. Two 1250 horse-power dynamos at the back-

pressure is transformed down again to 2400 volts, and at the houses there is a further transformation of this 2400 volts to 100 volts. There are, therefore, no less than three transformations of pressure between the dynamo terminals at Deptford and the lamps in the houses in London.

London-med as a gigantic experiment in electrical engineering, the Depthord scheme has achieved a gallant victory, for, with a buoyancy that no disaster could crush, and with the determination of a Napoleon to conquer every mechanical and electrical obstacle in the way. Mr. Ferrandi has seep by step succeeded in distributing current to guilty distant parts of London as the pressure which was the support of the control of the service of the support of the service of the service when the base serven months he has been sending the power to

water might perhaps be employed to work condenung accumulations, but such economies can only compensate for a freeign of the yearly interest on the capital expended on the Deptord scheme. Indeed, even if the station at Deptord had been built with rigid economy, and only large enough for the present demand, it is questionable whether the loss of power in three transformations of the pressure would not eat up much of the saving that could be effected by having the generating station quite out of London

formations of the pressure would not cat up much of the saving that could be effected by having the generating station quite out of London As it is, however, the London Electric Supply Company have been so engrossed with the electric lighting to London in the Juffert, that they have practically ignored the present wants of the householder, the vast building at Deptind has been constructed to carry a second story

of boilers and engines, when it is very doubtful if even the present story can be wholly utilized for a long time to come; rows of boilers and furnaces were erected some two or three years ago to supply steam to drive dynamos which are not yet made, tens of thousands of pounds have been expended on machinery to be employed in constructing two ten-thousand horse-power dynamos, and the armature of one of them, 43 feet in diameter, has had to be left abandoned only half finished, hecause there is neither money nor present need for such a dynamo at

Deptford. And while all these provisions for the future electric lighting of London on a vast scale were slowly proceeding, the present customers were left sometimes for hours, sometimes for days, and occasionally even for weeks in darkness: what wonder is it, then, that all over London there have have been growing up central stations supplying a direct current at low pressure, and that many of the house-holders who formerly received current from the overhead wires of the London Electric Supply Corporation

head wires or inc London Lectric Supply Corporation have had their houses connected instead with the low-pressure underground mains of other companies? To the world at large, however, the Deptford under-taking has been of immense value, for it has shown the possibility of practically using the very high potential differences absolutely necessary for economically transmitting power over such distances as that between between base wires running for 109 miles along the side of the Neckar railway, at a height of only 16 feet from the ground, sounds much less startling now than did Mr. Ferranti's proposal made and acted on five years ago to bring only one-tenth of this pressure, by means of india-rubber covered conductors, into locked transformer rooms built of brick in the basement of the houses supplied with current from the Grosvenor Gallery

In fact, the results that have been attained through Mr. Ferranti's undaunted courage, and the well-filled purses of his friends, have led people to look on a pressure of 20,000 volts as they regard a velocity of 70 miles an hour, so that to day, in order to prevent boys climbing up any one of the 3000 ordinary telegraph poles which carry the wires from Lauffen to Frankfort, it is thought sufficient to merely paint a skull and cross-bones on every post as an indication of the deadly fate that awaits the climber.

MY DEAR LORD RAYLEIGH,—As you are aware,
MY DEAR LORD RAYLEIGH,—As you are aware,
24/9/9/10 ill a fortught after its date; and my reply has
been further delayed for a week in consequence of the
closing of Edinburgh University Library at this season
Evennow I can refer only to the German version of Van der Waals's pamphlet

or waars pamphiet Partly on account of its unfamiliar language, but more especially on account of a very definite unfavourable opinion expressed by Clerk-Maxwell (NATURE, 15/10/1). I did not attempt to read the pamphlet when it appeared; and It was not till 1888 that, in consequence of some hints from Dr. H. Du Bois, I hastily perused it in the Germán form.

from Dr. H. Du Bois, I hastily perused; in its Germán form. The passage which you quote from my pager (where, by the way, the printers have unfortunately put resistance for resistance; to certainly not a very accurate description of Van der Waals's method, but it represents faithfully the difficulties which I felt on first reading the pamphet. I said that 'Vign der Waals's "justification of the introduction of the tergé pir ion to an account altendy closed, as it were, We have to thank the Electrician and the Electrical Review for some of the illustrations used in this article.

escapes me." And I am not surprised that it did so. For the statement of Clerk-Maxwell had prepared me to look for error; and when, at the end of Chap. VI., I met with the formula

$$p(v-b) = R(1+at),$$

which, a couple of pages later (nothing but general reasoning intervening), somehow developed itself into

$$\left(p + \frac{a}{a^2}\right)(v - b) \Rightarrow R(1 + at),$$

I naturally concluded that this was the matter adverted to I spoke of the first of these equations as a "closed

to 1 spoke of the first of these equations as a "closed account," because of the process by which b had been introduced. To this point I must presently recur. I had not examined with any particular care the opening chapters, to which your letter chiefly refers, probably having supposed them to contain nothing beyond a statement and proof of the Vinail Theorem (with which I was already familiar) along with a reproduction of a good deal of Laplace's work.

Of course your account of this earlier part of the pamphlet (which I have now, for the first time, read with care) is correct. But I do not see that any part of my care) is correct. But I do not see that any part of my statements (with perhaps the single exception of the now italicized word in the phrase "the whole procedure is erroneous") is invalidated by it. No doubt, the sudden appearance of $a/\sqrt{2}$ in the formula above quoted is, to appearance of alvo in the formula above quoted is, to some extent at least, accounted for; but is the term correctly introduced? The formula you give would lead, on Van der Waals's principles as to the interpretation of \$2(mV^2), to

$$v(t + K) = R(1 + at).$$

$$v\left(p + \frac{a}{v^2}\right) = R(t + at)$$

But how can the factor ($\nu - \delta/\nu \tau$, which Van der Waals introduces on the left in consequence of the finite distinction of the particles, be justicably applied to the term in Van der Waalse theory; for without it the resulting equation will not give a cube in ν , and cannot therefore be applied to the isothermals for which it is required. And, in any case, it could searcely be said that the K term, after being manipulated in this manner, is, in any strick sense, "extracted from the term $2(N_{\nu})$ ".

A very strange thing appears, in this connection, in the German version. A result, due it seems to Lorentz (which, in ignorance of his work, I had reproduced and published in the first part of my paper), leads directly to the equation

$$pv = R(1 + at)\left(1 + \frac{b}{2}\right);$$

which is then put in the confessedly approximate form p(v-b) = R(1+at).

Of this it is remarked.—" was genau mit dem obigen Resultate [that obtained by the use of the factor (v-b)/v] ubereinstimmt." It is obvious that, when we have to divide both sides by v-b, we ought to restore the proper factor on the right; and thus that the equation ought to take the final form

$$p + \frac{a}{v^3} = R(t + at) \frac{v + b}{v^3},$$

instead of the more convenient form

$$p + \frac{a}{v} = \frac{R(1 + at)}{v - b},$$

in which Van der Waals employs it. But then it would

not give the required cubic in v'

I think that the mere fact of Van der Waals's saving (in a passage which is evidently applicable to his own processes, though it is applied only to that of Lorenty, "die ganne Rechaung doch nur bus auf Grossen der ersten Ordsung (wee http://die.ganne Rechaung doch nur bus auf Grossen der ersten Ordsung (wee http://die.gann. ist" throws very grave doubt on the whole investigation. For in the most interesting part of the critical isothermal of CO₂ the fraction http://die.gann

For, if we take the experimental test, there can be no doubt that; as I have stated in , §6 of my paper, "Van der Wash's curves cannot be made to coincide with those of Andrews". And I think I have given reasons for beheving that "the term of Van der Wash's equation, which be rook to represent Laplace's, is not the statical which be the control of t

Believe me yours very truly,

St. Andrews, September 28

THE EXISTING SCHOOLS OF SCIENCE
AND ART

 \boldsymbol{A}^T a meeting of influential science and art teachers held at the Charterhouse School of Science and Art, Goswell Road, on the 3rd instant, the position of existing schools, with regard to the fierce opposition offered by highly endowed Polytechnics, was calmly and broadly discussed.

For many years, under the system not only recognized but encouraged by the Science and Art Department, schools have been established in London and the probable of the properties of the propert

By recent Acts of Parliament agreat impetus has been given to that side of science and art instruction known as technical education. Funds which in past times could only have been raised by persistent begging are now forthcoming almost as a matter of routine. In the provinces there is every sign that the authorities having the administration of the grant of public moneys intend to recognize existing schools. In London it is not so Schemis for the erection of new buildings are pushed officing agod work. At the meeting of teachers already referred to several instances were cited. The People's Palaco, erected almost in the very shadow of the Bow and Broniley Institute, has, by reason of its endowment, greatly hampered and herased the older institution.

The West London School of Art succumbed two years ago to the state of the Regen Street Polytechnic, and now the St. Martin's School of Art, one of the best known centres of instruction in the metropolis, has closed at doors. Without endowment it could not compete this more favoured rivals. The closing of this school is the more to be regretted because of the high tone of the work carried on within its valie.

Unfortunately, it cannot be densed that many so-called schools of science and art are simply carred on as "grant-earming" establishments, and the country would lose little or nothing if they were closed at once. But there are others affording excellent science and art instruction; and though these may not be affected by the present Joly-the erection of other buildings will, if not properly thecked, raise an undigmed competition with the older schools it is therefore a matter of great public importance that the established mustuleness should not be overclosed by the London County Council If new buildings are deemed the treated as the nucleus of the enlarged scheme out.

Two points of errors eem to be apparent in the plan of campaign of the supporters of Polytichius «(1) that educational work must be associated with recreation, and (2) that te.hincal education has a very limited area, and that science and art education in its fullest sense is unnecessary.

"Schools of art," said a goilleman to me recently, "are dead" Surely nothing could be more about. As I understand technical education, it is the application of general principles to a specific purpose Schools of science and art—r schools for it estudy of science as science, and art as art—should be encouraged as much as before. This can be done without interfering with the specific application of such study to a particular purpose

With regard to the question of seferation, I thinke would be found that, allough those institutes which make much of athleticism and such matters attract the largest proportion of students, the attendance per ratio in the classrooms, and the results obtained there, would not favourably compare with a mistitute carrying on its purely checked the students of the classrooms, and the results obtained there, would not favourably been connected only seven students entered the class, scores of young men could be found in the billiard-room and gymnasum At the Seence and Art Institute, and gymnasum At the Seence and Art Institute, in the country, it was decided to cluse the billiard-room in consequence of the serious effect it had upon the attendance of students at the classes. I am personally acquainted with the science and art work carried on at the Regent Street Polyrechnic Excellent as it is, it would be resembled.

The London County Council has shelved for a time the appropriation of the funds provided by the Excise Act, 1850, for the promotion of technical education But the matter must soon come up again. Healthy competition is excellent, but that the state of the state of the council to the state of the state of

In concluding, I would point out that the exponents of technical instruction are too keen on "centralization." Let us have large buildings with costly apparatus and every convenience, but do not entirely crush the small schools. To the working man with limited time and means, weary with his day's toil, a modest school close at hand is of greater service than a huge building six miles away involving railway fare and loss of time. By careful involving railway fare and loss of time. By Carestii arrangements such smaller schools can be preserved, and largely used as "feeders" for the institutes of magnitude. The whole matter, therefore, of science and art schools and future Polytechnics should be referred to duly quali-

There is no reason why existing machinery should not fit in with the new plant to make an harmonious OLIVER S DAWSON.

whole.

MOTES

THE autumn meeting of the Iron and Steel Institute was opened at the Royal Arsenal, Woolwich, on Tuesday, the greater part of the day being devoted to an examination of the various departments of the Arsenal, On Wednesday papers were discussed, and to day visits are to be made to the Naval Exhibition, the Enfield Small Arms Factory, and the Thames Iron Works. We hope to print next week an account of the proceedings,

An exhibition of cone-hearing trees and shrubs, asters, and sunflowers, and a conference upon them, were opened in the Royal Hortieultural Society's Gardens, Chiswick, on Tuesday. Large numbers of consiers were sent from various parts of the country, no fewer than 30 collections coming from Scotland The first prize was awarded to the Dowager Marchioness of Huntly for her collection of conifers, the second to Lord Wimborne The largest araucsuan cones were sent from Lady Fortescue's. at Dropmore, Maidenhead, where there is an araucana 68 feet high-the tallest male araucaria in this country Kew Gardens contributed about 200 different confers. On Tuesday papers were read on asters and sunflowers. The conference on conifers began on Wednesday, and is being continued to-day

A COMMISSION of engineers representing the various European Powers is to meet shortly at Cairo to consider the question of a storage reservoir, and to advise the Egyptian Government on the subject. The Commission will be required to select a site to the north of Wady Halfa, or within the present limits of Egypt.

THE organizers of the International Folk Lore Congress are to be congratulated on the success of their undertaking. The attendance was good; many excellent papers were read; and there were animated and suggestive discussions on most of the problems which are now of especial interest to students of folklore. Mr Andrew Lang, as President, delivered the opening address, in which he presented a most interesting statement of what he conceives to be the fundamental principles of the science. Admirable addresses were also delivered by Mr. Sidney Hartland, Prof. Rhys, and Sir Frederick Pollock, who presided respectively over the Sections devoted to folk-tales, mythology, and institutions and customs. The members of the Congress dened together at the Criterion Restaurant on Tuesday

STUDENTS of psychology and philosophy will read with regret Prof. Croom Robertson's "valedictory" words in Mind, from the editorship of which the state of his health makes it necessary for him to retire. For sixteen years he has done his mark as edstor with conspicuous ability and success. A second series of the Review will be begun next quarter. It will be under a co-operative direction which promises, Prof. Croom Robertson thinks, "a far more effective covering of the ground of psychology and philosophy than has hitherto been attained."

THE seventh of the series of One Man Photographic Rubibitions is now being held at the Camera Club. It is open to visitors from 10 a.m. to 4 p.m. on presentation of cards, which can be obtained from members or from the Hon. Secretary. The exhibition consists of photographs by Mr. Ralph W. Dahinson

WE learn from the Bolanical Gazette that Mr. O. F. Cook, Instructor in Biology at the University of Syracuse, U.S.A., intends starting about November 1 in charge of an expedition to Liberia and other parts of Africa, with the object of studying the natural history of the country, especially the plants and insects Mr. Cook will be glad to hear from anyone who would like to have material from that region

YESTERDAY evening a meeting of the Medical Society. University College, London, was held in the Boianical Theatre, University College. Dr W H, Gaskell, F R.S., delivered an address on a new theory of the origin of Vertebrates, deduced from the study of vertebrate anatomy and physiology

THE Belgian Minister of Public Instruction offers a prize of 25,000 france for the best memoir on the meteorological, hydrological, and geological conditions of the countries of equatoria Africa, regarded from the sanitary point of view. The subject must be studied with special reference to the welfare of Europeans resident in the Congo State.

In the Proceedings of the Academy of Natural Sciences of Philadelphia for 1891, some parts of which have just reached us, there is an excellent memoir of the late Dr. Joseph Leidy, by Dr Henry C Chapman. It is followed by a list of Dr. Leidy's numerous writings

IN a valuable paper on the "Rapakiws," J. J Sederholm, o the Geological Survey of Finland, has furnished petrographers with a trustworthy description of the mode of occurrence and minute structure of a granitie rock which has excited much interest, but has hitherto been very imperfectly understood. The official maps of the district where the Rapakiwl is found, with the accompanying memoirs, were published about a year ago : and the last number of Tschermak's Mineraloguichen und Petrographischen Mittheilungen, now edited by Dr. F. Becke contains a full discussion of the petrological peculiarities of the rock Writing from the famous laboratory of Heidelberg, Herr Sederholm naturally adopts the nomenclature of Prof. Rosenbusch, and it would appear from his description that the Rapawiki will have to take its place among the numerous types of "granophyre" (using this term as Rosenbusch does, and not as originally defined by Vogelsang) which constitute links between the plutonic granites and the volcanic rhyolites. The excellent photographic illustrations accompanying the memoir give an admirable idea of the peculiar nodular structure of the rock, which has attracted to much attention to it. In the same journal, we find a second memoir by Herr Sederhoim, on the Archeen rocks of South-West Finland, describing a varied series of igneous rocks, and discussing the effect of dynamometamorphic action upon them. The general conclusions of the author agree with those to which the study of similar rocks in other districts has led Lossen, Roland, Irving, Lehmann, Williams, Reusch, and Teall,

EXCELLENT arrangements have been made for the establishment of a good system of technical instruction in Essex. organizing joint committee of the County Council and the Essex Field Club was lately appointed to deal with the question, and funds were placed at its disposal. This body has now assesd a preliminary schedule of subjects to be taught. Local technical instruction committees are invited to select from the list one or more subjects which they may deem specially suitable for their respective neighboushoods. When several such bodies, representing adjacent districts, have chosen a particular subject, the origanisting committee will select a teacher or lecturer, and anderworr to arrange a circuit for him comprising the contres needing his service, apparents and illustrations being provided by means of the fund for that purpose. By this seems the said of throughly qualified and equipped instructors may be obtained by the local committees at a cost considerably less than would be incursed of seed contra were to act independently.

STRENUOUS efforts are being made in Scotland to secure that the country shall be supplied with a sound and adequate system of technical instruction. An important public meeting will be held at Edinburgh, on Thursday, October 20, for the considera tion of the subject Lord Eigin will preside, and it is expected that several members of both Houses of Parliament, and others interested in the question, will take part in the proceedings The following are the provisional agenda -(1) Chairman's address, (2) report on action taken up to this time by Town and County Councils-(a) in England, (b) in Scotland-with reference to the application of the sums available for technical education under the Local Taxation (Customs and Excess) Act. 1890 : (1) the relation of the Local Taxation Act to technical (including commercial and agricultural) education, (4) report on various agencies already available for technical instruction in Scotland-(a) in rural districts, (b) in towns; (5) the amendments necessary in the Technical Schools (Scotland) Act, 1887.

This Nicholson Institute, Leck, of which for Philip Megans President, his stuest its Calendar for the session 1891—21, and as is damirable Calendar it it, presenting many wrated elements of Interest. In the technical school connected with the Institute there will be classes for the study of wood carring, modelling, seeding, hyperies, and other subjects and in the "second physicians," and produce the second physicians of the subjects and in the "second physicians" and produced the second physicians of the subject of the second physicians of the subject of the second physicians of the second physicians and solid geometry.

An Agricultural and Mechanical College is about to be established at Sdo Paulo, in Brasil, an endowment of 200,000 dollars having already been promised, and the further aid of the Government secured. The Presidency of the College has been offered to Prof. L. H. Bailey, the American botanist.

In the Report for 1891 of the Governors of the Baltimore Fishing School, an Interesting sketch of the history of the institution is given. The progress of the school encourages the Governors to believe that its success will prove of great advantage to Irish fisheries. They point out, however, that its operations are not on the enlarged scale originally contemplated; and to all who can appreciate the importance of the youth of the Irish coasts being trained in remunerative industrial pursuits, the Governors appeal for contributions to enable them to extend their work The boys are thoroughly instructed in everything that pertains to the labours of fishermen. They also receive the literary education usual in such establishments; and a special class has been formed for the teaching of elementary navigation in connection with the Science and Art Department. At the last examinstion in this subject twenty-four pupils presented themselves Of these, not one failed, twenty-two passing in the first division, and two in the second

We have received from the Meteorological Conneal a copy of the "Meteorological Observations at Studens of the Second Order" for the year 1887, containing observations and results for 66 stations. At 21 stations the observations taken at 9th, nm. and 9th, pm. are practed in acteurs, and the whole work is on the same plan as in the volume for 1886 (NATULE, vol. 2011, p. 20), via the bacometer observations are given whither freedenin to see-level, and the differences between the grand uset built thermometer ceedings are given as the "degression of set-bold." The maximum can inflations the video-

meters are read at 9h. p.m , and the readings entered to the day on which they were read. The rainfall is measured at 9h. a.m., and the amount registered entered to the previous day. Fog is only entered when the observer is quite enveloped in it. This work has been continued in a more or less complete form since 1866 (when, however, there was only one station); and the summaries contain, sater alsa, very useful resumes of the state of the weather and wind-distribution, and afford excellent materials for preparing a revised climatology of the British Isles. The work is accompanied by a key map, showing the distribution of the stations, and indicating those which belong to the Royal and Scottish Meteorological Societies it will be seen that all distracts are well represented except, perhaps, on the more exposed western coasts and islands A special table is also given, showing the number of hours of bright sunshine in each month for those stations at which sunshine recorders exist

THE Chief Signal Officer of the U S Army has, just before the transfer of the Meteorological Service to the Agricultural Department, issued three atlases, bearing upon the meteorology of the Housed States, showing-(1) The isolars, isotherms, and winds for each month from January to December for the years 1871-73, 4 period prior to the regular publication of the monthly chaits The data used include all the materials possessed by the Smithsonian Institution (2) The probability of rainy days, prepared from observations for 18 years (1871-88) The average number of such days for all months and for each station has been calculated, and the percentages thus obtained are graphically shown on the charts. The data show great differences of distribution of rainfall in localities not far distant from each other; the influence of the prevailing direction of the wind in increasing the number of rainy days is particularly noticeable in the Lake region, (3) The average monthly cloudiness for the period 1871-Cloud observations show indirectly the relative amount of sunshine, as it may be assumed, within reasonable limits, that the complement of cloudiness will be sunshine. The investigation of this element is useful in determining the suitableness of certain localities for health resorts, or for the ripening of crops, and the charts may be considered as standard cloud maps of the United States.

De Kind, Director of the Bidnical Survey of India, has used a Report on the working of the Bonancial Survey in Assan and Burmah, for which 2002 repea are annully allowed, whi wire to arranging a plan for working by native collectors. Dr. King vailed Assan in the latter half of hat year, and found the local authorities ready to afford every assistance. Two native collectors were secured, and set to work near Golighds, and in the Knaist Hill be The Conservator of Forest also seen a large number of specimens to the Herbarum at Collection, and a Eurosau collector was employed for a time in Cachar, more consistent of the Conservator of the Conservator of the Conservator of the Conservator of the Conservation of the Conser

Dr. Paarn, the Cursion of the Herbarium of the Calcium Ensurial Genetics, accompaned the surveying the Journal Journal Confession design design part of her operations in the Bay of Heeps law and the case of the Creek Cook Island for a few days, and was the easibled to pay solely right to the Little Cook and to Entitled District State of the Creek Cook Island for a few days, and was the easibled to pay solely right to the Little Cook and to Entitled District. Except for the vipit match by a Cook and no before been explored by a blandful, that Little Cook and Resisted Headan were this year wisted for the first time. Accounts of these visits are to be officially positived in dec course.

A NUMBER of small expeditions in the Chin Hills and on the Bhamo frontier of Upper Burmah have been arranged for next cold season. In the Chin country, a column will explore the Chinboh country, and four other columns will visit the Baunghshe, Tashon, Tlangton, Kanhow, and Nwengal tribes. In order to effect a settlement of the Kachyen tribes, columns will be sent out from Bhamo, Moroung, and Myltkynia. An expedition will also proceed to explore the amber-mines and the indus-rubber tracts, and, if practicable, join hands with Assam,

To estimate the relative ments of different kinds of points for lightning conductors, Dr Hess recently collected and examined nineteen heads of conductors that had been struck by lightning (Riectrot. Zetts) His conclusions are as follows: (1) the fusion of points of lightning conductors by lightning causes no danger of fire through scattering of fused drops, for this does not occur : (2) fine and smooth points receive the lightning stroke in concentrated form, while sharply angled and ribbed, also blunt points, divide it into threads . (3) platinum needles and tips have no advantage over copper points ; (4) there are lightning strokes which are capable of making brass wire 7 2 mm. (say 0 20 inch) thick, incandescent. Unbranched copper conductors should therefore never be thinner than 7'0 mm

In submitting to the Wellington Philosophical Society some "Coccid Notes" lately, Mr. W. M Maskell expressed regret that entomologists generally did not devote more attention to the Cocoldee. He believed he was the only person in New Zealand who had published anything on the subject. In the Coccider there was infinite variety—a variety of life-history, habits, and customs that seemed greater than that afforded by any other branch of entomology. He gave instances of piculiarities in these insects-wonderful vitality in some cases, and the boring habits of one particular insect after it had thrown off legs, mouth, &c -all tending to prove that these little despised creatures were more interesting for study than "all the butterflies"

FARMERS in many parts of Victoria seem to be fully alive to the necessity of adapting their methods to the conditions under which they have to carry on their work Mr David A Crichton, in a report printed in the latest Bulletin (No 12) of the Victoria Department of Agriculture, says that, although farmers are supposed to be too conservative in their practice to do much in the way of new industries, he has been agreeably surprised to find that a very large number are anxious to try crops other than cereals Fruit culture in particular is attracting great attention, and he feels confident that before long it will become one of the stanle agricultural industries of the colony He is doing his bes to stimulate this particular industry, and, In addition to the information afforded by his lectures, he makes it a practice to visit as many places as possible, to advise upon the selection of sites for orchards and vineyards, and give practical lessons in pruning, training, and other matters. He finds that this assistance is highly appreciated, and his services are in great demand in this respect Mr Crichton's position in connection with the Victoria Department of A reculture is that of "the fruit and special industries' expert '

MR. JOHN H COOKL is publishing in the Mediterranean Naturalist an interesting series of observations on the geology of the Maltese islands. In the September number he refers to Cala Helv, a little bay between Comino and Commotto. On a bright day, he says, this bay presents an endless succession of the most brilliant colours, "which commences with a deep blue, and from thence passes through every conceivable gradation of green, orange, and white, after attaining the last of which it again graduates onward in the distance to that cerulean blue that is so characteristic of Mediterranean waters." The setting of the picture is not less effective than the picture itself. Arous the bay are many caverns, which have sombre-looking entrances | describes, for the first time, the neutral sulphate of hydrasine

and wildly-fantastic shapes. The sides of these caverns are full of interest for geologists, as "they literally teem with the remains of creatures that formerly lived and died in the waters in which the islands were built up

MR. W PRENTIS, of Rainham, Kent, describes in the October number of the Zoolsgust an Interesting case of a wild duck's foreth night. A mowing machine was set to work round the outside of a field of Jucerne bordering a marsh, diminishing the circle each time round the field, leaving about two acres in the centre. A wild duck was seen by the shepherd to fly from the piece of lucerne that was left with something in her beak, and, happening to fly near him, she dropped a three parts incubated egg. She was again observed by the shepherd, and also by the

sheep shearer, carrying another egg in her beak, this time over the marsh-wall towards the saltings, and again she was seen for the third time carrying an egg in her beak in the same direction. Next day, when the field was "finished" by the removal of the last piece of lucerne, the wild duck's nest from which the eggs had been removed was discovered.

MR. W. H HARRIS, Ealing, records in Nature Notes (September (5) a remarkable instance of "fringality" in bees. The recent extremely rainy weather seems to have suggested to his bees that there would probably soon be an end of honey-making. Accordingly, although there was " a crate of fairly filled sections above the stock-box," they adopted vigorous measures to prevent future inconvenience "It is a positive fact," says Mr. Harris, "that my bees, not content with ejecting larvæ of both drones and workers, proceeded to suck out the soft contents of the corpses, leaving only the white chitinous covering, which had not hardened sufficiently to prevent the workers from piercing it with their mandibles, and then inserting their tongues,

MESSES R FRIEDLANDER AND Son, Berlin, send us the latest of their catalogues of botanical books. This list, besides various works on the distribution of plants and on botanical exploration, includes a great number of writings on the flore of different parts of the world

MESSRS KFGAN PAUL, TRENCH, TRUBNER, AND CO. announce the following books on scientific subjects :-- "Colour Blindness and Colour Perception," by F W Edridge Green. M D., with three coloured plates (International Scientific Series); "Descriptive Catalogue of the Nests and Eggs of Birds found breeding in Australia and Tasmania," by A J. North, with 21 full page plates, "English Folk Rhymes," by C F Northall ; the following volumes of a series, "Modern Science," to be edited by Sir John Lubbock-"The Cause of an Ice Age," by Sir Robert Ball, F.R S , "The Horse : a Study In Natural History," by William Henry Flower, CB, "The Oak a Popular Introduction to Forest Botany," by H. Marshall Ward, FRS, "The Laws and Properties of Matter," by R. T. Glazebrook, F.R.S. ;-"On Seedlings," by Sir John Lubbeck, with numerous figures in text: "How to Use the Ophthalmoscope," elementary Instruction in ophthalmoscopy, by Edgar A. Browne, fourth edition, completely revised; "Principles of Political Economy," by Arthur Latham Perry; "Moral Order and Progress," an analysis of ethical conceptions, by S. Alexander, second edition (Trubner's Philosophical Library); "Chemistry of the Carbon Compounds, or Organic Chemistry," by Prof. Victor von Richter, authorised translation by Edgar F. Smith, new and enlarged edition.

Two more papers by Prof. Curtius, upon the reactions of the hydrate of his recently iso'ated hydrazine or diamidogen, NH, , are contributed to the most recent numbers of the NH_2

Journal fur praktische Chemie. The extler communications

(N₁H₃), H₂GO₂. Hydramae is found to form two sulphates—an add one, NiII, I, I₃GO₃ and the neutral one now described. The acid sulphate is a beautifully crystalline salt—an account of which was given in NATURE, vol. kim. p. 205. It is distinguished by its high melting point, 25° C, and its distinguished by its high melting point, 25° C, and its distinct solution. The neutral sulphate now described is obtained by evaporation of the solution formed by neutralizing hydrama hydrate with distlet sulphuriz each, first, over a water bath, and finally, as the new sail is very deliquencent, as neuron. It crystallines in large brillian tables, melting at 85°, It is prespirated exhaults in large brillian tables, melting at 85°, It is prespirated values in large brillian to a fine was 10° C, which is the summarized with a gilass root, and in contact with a small crystal of the sail, numediately solidifies to a fine mass of crystal, which, like those obtained by evaporation, consust of an hydroxin (N₁II), II, I₁C, and its distribution of the consumer of the consumer of the proporation, consust of an hydroxin (N₁II), II, I₁C, occussed of the solid presporation, consust of an hydroxin (N₁II), II, I₁C, occussed of the solid presporation, consust of an hydroxin (N₁II), II, I₁C, occuss of an hydroxin consumer of the solid preservation (N₁II), II, I₁C, occussed on the consumer of the con

THE second and much longer communication describes an important series of new compounds, the ketazines, obtained by the action of hydrazine hydrate upon ket new: The simplest of these new substances, the one obtained by the action of hydrazine hydrate upon acctone, is represented by the formula CH₂.

CH₂.

CH₃.

CH₄.

When bydrazine hydrates is dropped.

CH — When hydrazine hydrates dropped Upon acetone, a most violent reaction occurs, resulting in an explouon unless the acctone is surrounded by a freezing mixture When than moderated, however, the substance above formulated is produced together with water, the reaction occurring according to the following counting:

$$^{\text{CH}_{8}}_{2}$$
CO+N₈H₄ H₈O= $^{\text{CH}_{8}}_{\text{CH}_{4}}$ C=:N-N-C $^{\text{CH}_{8}}_{\text{CH}_{4}}$ +3H₄O

By allowing the product to remain for some hours in contact with caustic potash the water is removed, and upon distillation the new ketazine passes over in the pure state. It is a clear liquid possessing a sharp odour somewhat resembling that of the alkaloid coniine. It boils without decomposition at 131°. By employing other ketones, such as methyl ethyl ketone, diethyl ketone, and others of the same type, a large number of these ketazines have been prepared. Those containing fatty radicles are liquids, and those containing aromatic groups are solids. The lowest members only dissolve in water, the solubility rapidly disclaishing with mcrease of carbon atoms. Acids decompose them in the cold, with assimilation of water, into their constituents; towards alkalies, however, they are comparatively stable. Light exerts a decomposing action upon them, specimens placed in bright sunshine rapidly becoming yellow. Reducing agenta, such as sodium amalgam, are without action upon them, and they appear further to be incapable of reducing either Fehling's solution or (except after long boiling) ammoniacal solutions of silver salts.

Tits addutos to the Zoological Society's Gardens during the past fortight include ta on— Commonate (Palaicarseurs, 19, Inc.). From New Zealand, presented by the Lati of Onslow, 18, Inc.). From New Zealand, presented by the Lati of Onslow, 18, Inc.). GCM.G. j. a Verwit Monkey (Crospitheus Indansel 9) from South Africa, a White-fronted Lemus (Lenus althytous 9) from 14, Inc., I

NO. 1145, VOL. 44]

Messrs A. H. R. and F. R. Wollaston, a Macagne Monkey (Micacus cynomolgus ?) from India, presented by Mrs. Gwynne; an Indian Civet (Viversuila malaccents) from India, presented by Mr. Herbert Courtney Hodson, two Chilian Sea Eagles (Go anoastus melanoleucus) from Chili, presented by Mr. H Berkeley James, F Z.S., two Grev-breasted Parrakeets (Bo'borhynchus monachus) from Monte Video, presented by Mr J. C Wallace, two Nightingales (Daulias Inscinsa), two Common Whitethroats (Sylvia .inerea), a Blackcap (Sylvia atricapilla), British, presented by Mr. J Young, F Z S., four Yellow Wagtails (Motacilla van), British, presented by Mr. W. Swaysland, a Common Cormorant (Phalacrocorax carbo) from Scotland, presented by Mr F T Barry, M.P., fifteen Striped Snakes (Tropidonolus sirialis) from North America, presented by Mr. J Gray , a Solitary Thrush (Monticola cyanus), European, a Macaque Monkey (Macacus cynomolgus) from India, deposited: a Sharpe's Wood Owl (Syrnium nuchale) from West Africa, a Testaccous Snake (Ptva: testacea) from Califorms, two Ouebec Marmots (A)ctomys monax) from North America, two Scaly Doves (Scardafella squamosa) from South America, purchased; a Ruddy-headed Goose (Bernicla rubidi-cebs) from Falkland, received in exchange

OUR ASTRONOMICAL COLUMN.

PURICAL APPRABACE OF PERIODIC COMET.—Comets possess op personal characteristic appearance, but Mr Barnard, writing to the Astronomical Point vial, No. 246, suggests that it may be possible to arriage those of short person according to the property of the

DISCOVERY OF TEMPEL SWIFT'S COMST —Mr. Bernard round this conset on Systember 28, and Mr. W. F. Denning choovered it independently two days later about 4 south-west of its computed positive. The comer bases perhelron in November. Its position, according to M. Bossert's ephemeris, as a follows.

	E	ohem	er 1.	i for	Par	u Mu	inight.		
1891	P	light h	Asc	епиог	•	Dect	inatios.	1	Brightness.
Oct. 6		21	6	2		+ 3	24-8		7.01
,, 8 10			6	19		3	54 O		7 77
,, 10 ,, 12				55	•	4	6.95		
,, 14			Q	9		6	308		8 61
, 16 18			10	48			6 4 43 9		9'54
,, 18	:		15				23'4		
,, 22						7 8 8	483	••	10.24
,, 24 ,, 26			21 24	50	••		34 0		11'64
,, 28			28	56		10	22'2		
30		21	23	30		11	128		1283

The comet is therefore in Equuleus at the present time, and moving towards Perasus.

PHOTOGRAPHIC DEFINITION.

T is a matter of some interest to determine what are the ilmits to the definition obtainable in photographs. In examining this question, three distinct classes of problems present them-

this question, time of an increases or proteins present themselves—namely.—

(1) Those depending on the wave-length of light, and the action of a perfect lens on such wave-lengths.

(2) The various abstrations of real lenses

(3) The qualities of the different sensitive surfaces on which

(3) The qualities of the dustreat sensitive stratects on which the pictures are formed. Taking these divisions of the subject in the order given, I will inquire first what is the limit to photographic definition on the supposition that the less has no aberation of any kind, *c that all the waves which reach it from any point arrive at the image.

of that point in the same phase. of that point in the same phase.

The image thus formed consists, as is well known, of a bright disk surrounded by alternate dark and bright rings, the intensity of the illumination of the rings decreasing rapidly at each successive ring, reckoning outwards from the centre.

All no dref that the images of two neighbouring points may seem to the contract of the contract of the received that the images of two neighbouring points may

Points nearer to, or further from, the lens than that which has its mage on the plate will be represented on the latter by round patches of light; these being the sections by the plate of the patches of real patches of the point, and for their slant the radius of the aperture—focal length. Thus, if \(\epsilon \) the stantance before or behind the plate of the focus of a point, it will be represented on the plate by a patch of light of diameter.

This diameter can be diminished by the use of a disphragm, i.e. by diminishing A, but this at the same time increases the diminishing A, but the same time increases the And the resulting average definition will be improved by diminishing A until the patch of light, representing the point most of focus, has the same diameter as the diffraction disk of the image point in focus.

If we suppose the photographic plate to be placed at such a distance from the lens that the focus of the nearest object is as much behind the plate as the focus of very distant objects is in front of it, we shall have, to determine the diameter of



Fig. t

appear separated from one another, the central disks of their images ought not to overlap. If the disks are just in contact, it is possible that they would appear as a double object in the photograph, and this may be taken as the limit of the defining power of a lens. (See Aly "On Light", and Lord Rayingh "On the Theory and Manufacture of Diffract, in Gratings," The Raying of the Control of th

But, in ordinary photography, objects at very various distances have to be simultaneously represented, and it is to the definition attainable under these circumstances that I wish now to direct attention.

On referring to the papers above-mentioned, it will be seen that the diameter of the central disk is

where A is the wave-length of light,

F the focal length of the lens. A the aperture of the lens.

This gives the effective diameter of the image of a point truly in iocus when not far removed from the axis of the lens.

the stop giving the best average definition, the following equation:-

Putting F = principal focal length,

D = distance of nearest object, $q = 1.210 \lambda$

$$q \frac{F + \epsilon}{A} = \epsilon \frac{A}{F + \epsilon};$$

$$\therefore q \frac{(F + \epsilon)^2}{A} = A^2 (1)$$

but, by the ordinary formulæ, connecting the conjugate foci of lenses, we have, if D = F + g,

$$2\epsilon_{ij}' = F^{i};$$

 \vdots $\epsilon = \frac{F^{2}}{2\epsilon'} = \frac{F^{2}}{2(U - F)};$

This is an approximate statement only. The true expression involves an involvestation of the intensity of the light knowledgesty in front of and behind a caustic

whence, substituting for e in (1) we have

$$A = \sqrt{\frac{q}{2}} \frac{2D - F}{DF} \dots (2)$$

Let the nearest object be at n times the focal length of the lens. Then, putting nF for D.

$$A = \sqrt{\frac{qF}{2}} \frac{2n-1}{\sqrt{n-1}} \dots (3)$$

This gives the value of A as a linear quantity; it is usual however, to reckon the diameter of stops as fractions of the foca

Dividing, therefore, (3) by F.

$$\frac{\Lambda}{F} = \sqrt{\frac{g}{2F}} \frac{2n-1}{\sqrt{n-1}} \dots (4)$$

From (4) the accompanying table has been computed, giving A for various values of F and n. (Fig. 1 gives the same graphically.)

Table showing ratio of aperiure to focal length which gives the best average definition when the nearest object to be photographed is at "n" time the focal length of the lens, and distant objects are also in view.

F	***	N=10	#m12	n= ≥0	###25	# = 3 0	n=35	N=40	n=45	#III 50
-				-			_			
ın.	00785	10110	6110	0150	0171	0188	3901	0216	£ 220	1244
3	00040	'00000	0106	0134	0137	0152	0165	9177	0188	0199
8	00554	00775	'0004	0107	0121	01 10	9142	0154	'0162	0172
10	00405	00000	00825	0005	3010	ori8	0120	9137	0146	0154
	00458	00635	007.5	0087	00038	oro5	0117	3125	0113	0141
	00422	บอรูสิด	00003	0081	cog1 '	0100	0108	0116	0123	0130
6	00392	00152	00551	0276	9985	0093	1010	0108	0115	0122
8	00170	B2520	00615	0071	OU83	oo\$8	0005	0102	0119	0115
90	00350	00404	00584	no58	0076	0084	00,00	0007	0103	0109

I have not before seen it pointed out that the ratio A, which gives the best average definition, alters with the value of F If a is the least angular distance between two points (as seen from the centre of the lens) which are shown as separate points on the photograph, a must at any rate not be less than 4, or

$$\sqrt{\frac{2d}{F}} \sqrt{\frac{N-1}{N-1}}$$

showing that, if the foreground is kept at a distance proportional to the focal length of the lens, the definition improves with an increase of the focal length.

On the other hand, if the nearest object is at some fixed dis-

tance. D. from the lens, we have as the limit for a,

$$\sqrt{2q} \frac{\sqrt{D-F}}{2D-F}$$

an expression which increases with F, so that for a given picture taken from a fixed position, definition will be gained by the use of a short focus.

The gain, however, is this respect is not great, for in practice D is always a considerable multiple of F, and writing

$$\sqrt{\frac{1}{4D + \frac{F^2}{D - F}}}$$
 for $\frac{\sqrt{D - F}}{2D - F}$,

it will be seen that when D is many times F, The R may be neglected in comparison with 4D.

Thus, in ordinary cases the limit for a is $\sqrt{\frac{q}{2D}}$, and is independent of the focal length of the lens employed.

If we inquire how close the nearest object may be to the lens

NO. 1145, VOL. 44]

when a view containing also distant objects has to be photographed with a definition reaching a certain standard, we have, on the above supposition,

and if we put a = t', which is often taken as the least angle separable by the unaided eye, and λ as write inch.

showing that if the picture is to appear as well defined as the natural objects themselves, to the 9 placed at the position of the lens, no object in the view must be nearer the later than about 73 feet?

Though, as above stated, the focal length does not affect the definition, when the right-stand ston is used.

definition, when the right-sized stop is used, it does the rapidity with which a picture may be taken, for the intensity of the light

with which a picture may be taken, for the intensity of the light on the plate is measured by $\frac{p_s}{k^2}$ or $\frac{q}{r} (\frac{2n_s}{n^2} - \frac{11}{n^2})$. That is, in these circumstances, the exposure is Inversely as the focal length.

All that has been higher to said refers to the definition in the

All that has been hutherto said refers to the defination in the central parts of the plate.

The definition for the oblique pencils is necessarily worse. For even if it were a sament that the lone was perfect for oblique years in the plate of the plate. The passemption, however, that a less is perfect for oblique pencils is too far resurved from extend fact to make it worth

while to consider the results to which such a supposition would lead

The definition for the marginal parts of the photograph depends on the various aberrations which all combinations of lenses suffer from in some degree, but which in well-made examples are completely, or almost completely, corrected for direct pencils.

These aberrations are (r) spherical, (2) chromatic, (3) astig-matism, (4) curvature of field.

The effects of the two last are much the most important, and will be considered first.



Let O (Fig. a) be the optic centre of the lens, OF the axis of the lens, and if the principal focus, Found PS the curres on the Far better by plane of the plate, F and PS the curres on the PS that the PS that is a far posted to the product of the part of the part of the post of the part of the post of the part of the post of the part of the oval patch of light whose axes are A 72 and A 72 in direc

tions parallel and perpendicular to Fx; A, as before, being the aperiars of the lens.

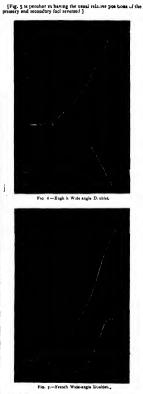
Any formals depending on the actual data of real combinations of lenses, and grimg the values of y, and y, in terms of radu of curvature and refractive indices, &c., of the lenses composing there, would be a very unmanageable thing for the

* I have verife ! th a with a lens of ro-nch focus.



ric. s.-French Portra t. possession (see Figs. 3 to 9). All these lenses except Fig. 5 are by makers reputed to be the best.

NO. 1145, VOL. 44]



The ordinates of these curves are the distances of the pripary and secondary locs from a place through the principal focus at

right angles to the axis of the lens, and are expressed as frac-tions of the focal kingth.

The abacisses are the inclinations (in degrees) of the pencils to

the ax s

Suppose; now, that the plate is placed at a distance e behind



the principal focus, e being half the distance between the fice for direct pencils of the nearest and distant objects.

The worst defined point in the centre of the picture will then be

represented as having a walth A nearly, while at the obliquity

 θ this width becomes $\frac{A}{K} = \frac{\pm y}{100}$ ne rly, according to whether it e



bro. 5.- Proplet

image under consideration is that of the most distant or the

image studer consideration is that of the most distant of the most point.

Hence, unless y is small compared with r, the defination for rays of obliquity 8 will be sensibly worse than in the centre of the plate, and a reference to the curves for y, a d y, shows at glance that that must be the case even at 10 for all the lenses

unless the general standard of the definition is lowered by a large value of s.

As an example of the use of the curves, let us take the rapid

reculirent No. 6, and compare the definition at 20° obliquity with that at the centre, supposing that the nearest object is as a distance of 25F.

This give e = '02F nearly, and at 20' y = - '023F, = + '046 F, hence we have as follows ---

This shows that while the nearest points at this obliquity are represented by long ovals placed as if radiating from the axis, the most distant points become similar but rather smaller ovals with their long axes at right angles to the former, and that the length of the ovals is about twice the diameter of the image formed by the direct pencils

formed by the direct pencis.

In the same way the definition, as far as it depends on astigmatism and cuivature of field, at any obliquity may be found fee any lens for which y, and y, are known Lauriston Hall, September 9

A. MALLOCK.

(To le continued.)

THE KOH-I-NUR-A CRITICISM.

THE true history of the Koh i Nur diamond, if it could be a singularly interesting one. But the historian would have a difficult task. The page task I purpose writing will be devoted to the criticism, possibly the refuting, of some fallacies that hang round the subject, but they will not dem with some other by-torical difficulties has I have not space.

sum with some other on-tonical dimediate that I have not space vent to indicate, but which do not belong to those portions of the history for criticism on which the following pages are designed. The period in the history of the Koh i. Nur I had has attracted the notice of all modern writers on the dismond, and to a degree, I think, somewhat beyond its impostunce, in the first degree. I think, somewhat beyond its importance, is the new or ten manutes during which the French diamond dealer, Tavernier, held in his hand the most important of the Crown pewels of the Empieror Aurungrebe It was a great diamord, and the record Tavernier has handed down in his "Voyage," of its weight, its

Fixtures has haded down in his "Voyage," of its weight, its form, and its history, will have to be critically dealth weight, it may be at once stated that the disputable point regarding from the control of the contro

an under to user time ground, I may say that waite attaching in the property of the property o

third during that century, the largest of which, however, was

very likely the Koh-i-Nur. But that one large diamond of the carlier time had been a famous atone for conturies. Legonds with substant black of the conturies. Legonds with substant black of the desired of the Koh-i-Nur black of the forestend centery. The tale was told briefly by Prof. H. H. Wilson is the sketch of the Koh-i-Nur which be contituted to the official catalogue and the Koh-i-Nur which have preferred the task than the great Orientalist and Satsorishelav, with his large expensees of Hindoc cutoms and modes of thought. And he wrote the notice with the statement by order of the Company at the time when the Koh-i-Nur became a Crown jewel of the Queen.

The latest historian of the Koh-i-Nur, Juneaus, darking the Company at the time when the Koh-i-Nur became a Crown jewel of the Queen.

The latest historian of the Koh-i-Nur, Juneaus, darking the conservant dipposit remark that "it has afforded sandry the somewhat dipposit remark that "it has afforded sandry the somewhat dipposit remark that "it has afforded sandry the somewhat dipposit remark that "it has afforded sandry the somewhat dipposit remark that "it has afforded sandry the somewhat single and the contraction of the Rosenski that the sandry that th

what disposat remark that "it has afforded anndry imaginative metres a subject for highly characteristic paragraphs of metres are not to the property of tended to the Patt Indus Company Labrary cannot be expected to treat Mr. King or say other man of learning less con-temptuously; but he qualifications for desting with the subject distanced dealer will, perhaps, be fairly called in question by the readers of the following pages.

Yet Dr. Ball, of the Science and Art Department in Dublin, has had Indian experience on the Geological Survey, an office that rask edserwedly high even among the great department between the control of the properties of the prop

author on subjects that came before hm in Judis as a geologist and a supporter.

Il is probably a sort of loyalty to the author whom he has and a supporter.

Il is probably a sort of loyalty to the control whom he has the supporter of the suppo fourteenth ceutury.

sway the accumulated treasure of Ujenn in the first decad of the contention beauty. It that press in Frankis for this compent, and then it was that the great diamond takes its place in the place in th

made in the previous century by Garcias de Orto (a Portuguese physican at the Vicerogal Court of Gos), against the largest dipplyment at the Vicerogal Court of Gos), against the largest dipplyment and the Vicerogal Court of Gos), against the largest dipplyment of Gos of Gos

organia stowers as Drikto susmoors, totac stave mere are super particular of Dr. Ball's, we may sak, What did De Boot mean by alleding in a second passage to the dismond Garcias had seen in India se weighing 1874 centa? At I have said, it is barely possible be had means external to Garcias' statement in his book of knowing the actual to the second of the second passage of the discourse statement in his book of knowing the Cluse were apothecary weights, waying conservant in different colattics in Western Europe from the corresponding divisions of the French ounce of 576 French grains, equivalent to 472 1875 trung grains. The weight of the diamond on the French systems of the French ounce of 576 French grains, equivalent to 472 1875 trung grains. The weight of the diamond on the French systems of the second passage of the systems of the second passage of the second pass

in Antwerp, it would be 176 95 troy grains. But none of these are cars: grains. De Boot, on the other hand, in estimating the 140 magnitude in 1755 carst, took the mangelin not at the 5 carst grains of Garcias, but at 5 3568 such grains, taking grains of Garcias, but at 5 3568 such grains, taking carst, the former being one among the several values which this variable suit had in different places.

The 1755 carsts of De Boot would, on the value of the distancest part of the Dutch troy mark, give a weight for the distancest part of the Dutch troy mark, give a weight for the Koba-Nur having been 359 3 iroy grains. It is wery difficult to scarrias in which accuracy the values of the different inst-marks, sometimes of the different continual manufacturing the scarriage of the different continual parts of the different continual parts of the different continual parts of the carling of the 450 manageline and the traditional weight of the complete form. There can be fittle doubt that Le Clince was no error in taking the spothecary weight instead of caral weight intended of the grains of caral weight intended of caral weight intended of the grains of Caral weight intended of caral weight intended of the grains of Caral weight intended of caral weight intended

in error in taking the apothecary weight instead of carat weight in translating the grains of Garcias.

It may be asked, Why devote so much consideration to this cassal statement of De Booch's? The answer is twofold. The astronomer has patiently searched in the records of early observations for any that might indicate the position at a former epoch of a new-found planet, and so, where the silence about an object of historical interest has been scarcely broken through an object of historical interest has been scarcely broken through two or three centures, one tests any observation of the casual wayfarer in the domain of hierature that may perhaps shed a ray of light on it. The other reason is that, if not disposed to resent, one is at least desirous to refute, attack on those who can no longer give their own answer to assailants of a new Can no longer give their own answer to assistants or a new generation, who perhaps may not bring to an investigation the learning or the patient temper of those who have goue from us, and carried great stores of scholarly learning into the silence Whether I am right or wrong in the explanation I have offered of De Boot's conversion of Garcias's 140 mangelins into offered of De Boo's conversion of Garcian's 140 imagellins into 1679 carist, I trust that at any rate I have shown cause for the heard of the Koh-i Nur. It being scarcely probable that two stones should be ce existent of that extraordinary weight." In dealing with another of those coincidences in weight to which alliand was made, and one example, of which has just

which aliusion was made, and one example or which mas just been discussed, we get on the delicate ground of the degree of confidence to be placed in Tavernier's facts and figures, and the not less delicate ground of a theory about the Koh-1 Nur, started by Dr. Ball, before which the other strange vicustitudes and

ny Dr. Ball, before which the other strange vicinstitudes and harbreadth escapes of that old talisman pale into masignificance. We have made sufficient acquaintance with the historic Indian diamond to leave it for a while, in order to introduce that other greater stone which we have designated as the "Great Mogul" Bernler, from personal contact with whom Tavernier no doubt derived much of what had an historical character in his volumes, describes the gift by Emit Jumls, a Persian adventurer of great ability in the service of the King of Goleonda, of a large diamond to the Emperor Shah Jahan, "ee grand diamant que l'on exime sans pareil." It was an appeal to his cupidity, and to a real same parent. It was an appeal to in a capitally, and to a reconnoisseur's passion for precious stones, at a time when the Emir was effecting a change in his allegiance from Golconda to Delhi—in fact, appealing to a new master to induce him to assail the old one.

In 1665, Tavermer, who was no less a contiler than a dealer,

inspect his jewels.

The Emperor, seated on the peacock throne, could see the ceremony that was conducted in a small apartment at the end of Tavernier describes the patient circumspection with the hall. Twernier describes the patient curcumspection with which he was not some and grevel by a Fernian which he was not some and grevel by a Fernian which he was not some and grevel by a Fernian diamond, "Gui set use rose (a rose-cut stone) ronde (rounded These was a small crack at the edge below, and a little face. These was a small crack at the edge below, and a little face which the state of the st

described it.

He proceeds to give his version of its history. It was the stone given by the Emir Jumla to Shah Jaban; but he adds that,

whereas it had then a weight of 900 ratis or 787½ carats, it was worked down by a Venetian diamond-cutter, Hortensio Borgis, till it had only the 280 carats weight above noted. The word egrates is that used; Dr. Bail interprets it as entirely ground down. But, though this is the most rational meaning of this technical word, if would, as Mr. King has remarked, have taken more time than the close of the wonths which intervened between the gift and the edipte of Shah Jahas for the mere gurding flown to have been accommended by the state of would, as Mr King has remarked, have taken more time than the them with sufficient attention and lessure to be able to assure the was that of the thrones which he previously had ample time to inspect. It will be noted he does not say he weighed any of the stones; nor does his doing so seem compatible with his description of the scene

But in another chapter near the end of the same book he giver a brief enumeration of the finest precious stones he had, in his long travels, known The diamond described in the earlier chapter is alluded to now with slight but immaterial variations or corrections as to weight; but lavernier here states that he was allowed to weigh the stone, and he further adds that it had the form of an egg cut through the middle Dr Ball truly notes that this proegg cut through the middle Dr Ball truly notes that this pro-cess may be performed in one of two ways-longutudially, or transversely, and that the Koh-Nur in 1850 represented the difference of form, as I shall explain, was the result of the mutilation to which it was subject." Tayernier's statement that the diamond was "fort heated d'un Tayernier's statement that the diamond was "fort heate d'un

Tavernier's statement that the damond was "fort haste d'un cide" seess, indeed, hardly to accord with any other than a longitudinal section of the egg.

Tavernier appearate to this later chapter—written or edited probably by another hand four or five years after the event of the handling the stane—a role section of the great damond akt.th from memory of a semi-egg shaped stone seen "end on," or of a crows-cut half egg seen from any point of view, but, except for the trace of a small underest fisce in his projection, it was very slightly larger than the length of the Window dismond. is very slightly larger than the length of the Windsor diamond. but in no other dimension does it at all compare with that stone as it was in 1850

as it was in 1050

Then there is the question of weight
Babar's diamond, we have seen, weighed about 8 mishkals, or, in Indian weights, about 330 ratis (gold ratis)
This would correspond to '240 pearl ratis, or may be represented as 224 of the Deccan ratis of Fernshia.

Fernhia.
The diamond Tavernier saw weighed, he said (was he untrily told to, or fid he really weigh it?), 3763 ratio, only half a rail told to or fid he really weigh it?), 3763 ratio, only half a rail those which Babar reckoned by, and his carsts (or cared) must (race Dr. Ball) have been French carsts. Dr. Ball upposes he as contributed to the published das of this tangle of contribution of the state of the stage of contribution of the stage o points out.

points out.

That grattemen assumes from this that Tavernler always employed this casat in his calculations. Such, however, it quite appears to the control of the control of the control of the control of the property of th

tion of what seems to be indicated as his habit to many other instances. He gives the weights of stones he mentions in ratis or mangelins, or in mishkals, and projects to state the equior mangelins, or in multikals, and proceeds to state the equi-valent weight in terms of new caratt, s.a. of the Paras carat; for no Frenchman would designate any carat other than one current in France by such a term. It would be a tedious task to inflict on a reader the minute

detail of calculation and reference to statistical authorities that detail of calculation and reference to statistical authorities that would be involved in a critical study of Tavernier's assertions regarding Indian and other weights, or Dr Ball's incursion into that study. But one fundamental error must be alluded to, that vhiates

But one fundamental error must be alluded to, that whistes the accuracy of Dr. Ball's calculations II is possessed of the ungular belief that, in the sevenie end to castury, Taverner would be the system transitions or usual, which was introduced by the law of May 1812 into France, in temporary substitution for the old livre (posted to man, of 9246 French grains, and its enbdivisions.

It is quite unnecessary to follow the results of this error, for the only interest as regards our inquiry concerns the significance of the 319.5 ratis which Tavernier states the great dismond of Aurungsebe to have weighed. 320 ratis was the Hindon equivalent, in Babar's time, of the 8 mishkals of Babar's diamond, and the Koh I-Nur in 1850 weighed Babar 8

Tavernier says that the 319 5 ratis correspond to 280 French carata (no. carats) Here, then, is a second of those marvellous coincidences in numbers to which we have already made allusion—I may call them impossible coincidences, unless they apply to one and the same diamond

apply to one and the same dismond Dr. Ball sees, apparently, no difficulty in the recurrence of any number of these identical figures as representing the weights of huge diamonds. For his explanation of the matter is that the diamond Tavernier handled was, as the French meris that the diamond Twensier handled was, as the French mer-chant asserted, the stone that Berser mentions is the glft of Emr. Jennia to Shah Jahan; that it did weigh 319-3 ratis, but the state of the fact, to 875 of a caret, whereas Babba's raisu were only 528 of a carat. Dr. Ball's assertion, however, is that this great diamond is the Queen's Koh-i Nur, but that after Nadar Shah's time it had become diminished by successive chipoping state formed out by savely princes, who is succession owned it and sometime of the state of the state of the state of the sumably before it fell into the hands of Ranjit Singh, this great Mogul diamond had shrute in magnitude from its asserted 20c carat to 186 cantar—from the 3163 ratis of Tavernner's exchange to the 320 ratis or Bland's recknoning in a word, it and the state of the 8 mathkait of the Koh-i Nur in 1550. So here is a third connedence that we are called on gravely to access a serious coincidence that we are called on gravely to accept as serious

The only originality, however, involved in this singular view of history, and the way to write it, is the reason assigned for the whitting down of the diamond from the asserted 280 carats the whitting down of the damond from the asserted 200 cannis to 180 cannis Several ingenous persons have indiging before the Kobi-rum from several smaller once tentioral about the the Kobi-rum from several smaller once tentioral about the world, with a fine soon of shape and weight and "water" in the component fragments, and of any historical ground whatever the component fragments, and of any historical ground whatever even suggest the services of the great Kusansh damond in that means, ignorant, apparently of the facts that, live the Kohj-Num.

brownish-yellow hue.

But the coincidences in weight of various phantom diamonds with that which Babar recorded do not come to an end even

with that which Bahar resorded do not some to an end even with this crosmage wonder, as I shall pressurily above Perhaps some one may, in parenthesis, sak what evidence there is for the breaking up of a great diamond, by owners who close to the Kohl-kin with a teason; second didy to their state of the s

Hundoo atone? or if it was, as I have supposed, the Hindoo KohI Nur that Tavernier handled, where was the Great Mogal?
Tavernier awn o recond diamond of the first rank in magan
tode. But there were two great diamonds somewhere—Babar's
and Mir Jumils', or, as I have designanted them, the Koh-Nur
and the Great Mogal. One or other of these Tavernier has
described where was the one he did not see?

and the control of th It is now thirty-five years ago that I suggested the answer upposing, as I did and do, that Tavernier handled the Koh

representing the queen's olabbods, and even lest the distincts Aurungazhe.

The Great Mogul discribed, as he as wit, saming the 'treasures of Aurungazhe.

The Great Mogul discond had been cut by a European cutter distinct to the control of the co autition, probably in a river cea, that the angle between them was no longer quite the true occabedral angle. The facets in general presented an imperfect adamantuse lustre, and appeared slightly rounded, the result, probably, of the imperfect processes employed by the native Hindoo lapidary, especially in very early

times. Even Twernier's drawing radaly indicates three rows of facets, put on in a manner that hardly consists with the fashion of a rowe-cut classmond of European sevinanahaje, or a row-cut classmond of European sevinanahaje. The results of the r

aerchant translated this weight into carats, not as from the old airs of Baber's or even of Akhar's day, but from the pear ratis, of oer other valles, with which he had become sequented in the control of the control of the control of the control of the arts on the ratio of 1, who that he are control from the Tana-yanian, and as drawn from the various samements of equivalent respits it varies from a '2005, in one case 2 750, to 2 757 trop ratio. His method also be pairs at \$\$\text{it had person on the case of the control ratio. The control of the control of the control of the control \$7 tory grains; which should, however, probably have been \$\text{control of the control of the control of the control of the \$\text{control of the control of the control of the control of the control of the \$\text{control of the control of

ig ounces to the mishkal, and the rati of lavernier is entirely lissimilar to any known rati of ancient or modern India. The 319 ratis is readily explained on this hypothesis; and it is eally too large a demand on our credulity to believe that is of he largest diamonds, in the world should be severally of 3196. atis and 320 ratis, though of different units of value, when a impler explanation is able to dispose of the anomaly.

I have said that the marvellous coincidences of weight in nave said that the marvellous coincidences of weight imported nto the Koh i-Nur history do not come to an end with Babar's i mishkals, with Anselm de Boot's 1874 carats, with Tavermer's s mishkals, with America de Boot's 1874 c-rats, with navermers 1194 rats, nor even with Dr Ball's untraculous chipping process, resulting in a reduction of the Great Mogul diamond to the identical weight of the Koh-Nu'r in 1830. The original lamond of Babar had to be accounted for, and its phost had to be also also also another coincidence had to be imported into the ball. So another coincidence had to be imported into se laid. So another conscience had to be imported into the sarature, or rather into the formace Another diamonal had to se found, also will the present weight of the Koh is Nar, and this peak in the laid of the same and the sa

is a large tist distanted with bevelled edges, and in the form of a long rectangle. When Malcolui knew it, it was set in a glorous galaxy of mighty rables. He could therefore have only known is weight from hearsay evidence, and the recorded carais were most likely the echo of those associated with the fame of the most likely the echo of those associated with the fame of the Koh i Nur Now, I have no hesitation in assering this Darya-i Nur to be an old acquaintance of those familiar with Taveriner's pages. Unless two diamonds, flat, bevelled, and of identical dimensions, can be shown in comments. immensions, can be shown to co exist, of above 200 carats weight, the stone known as the Golconda diamond or the Table diamond

the stone known as the Colcount alamond of the labe alamond is no other than the Darya i Nar It happens fortunately to be one of the few stones described by Tavernier to the form and weight of which, as given by him, we can attach complete confidence. He had a lead model made we can attach complete confluence the man a reasonable from it in order to negotiate its sale and he gives its weight as 176) magelias, or 34,5, "de non exam", retream a region at 176 at

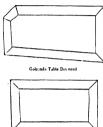
the Golconda: the Darva-i Nur = 10:85.

that is to say, the portion trimmed away was about 15 per cent. The remaining some would thus have a weight of about 26. The remaining some would thus have a weight of about 26. The remaining some would thus have a weight of about 26. The should be about 26. English carsis.

I would be about 26. English carsis.

I want I have been a some a som

the companion of the exist of binhi Sujah, and then tors from bin by the grant Loon of Labore—Free to its destroy as "the most of Labore—Free to the destroy as "the modes the stone that, from early times to 1850, preserved its form and weight of 8 mishkals, where was and where is now, the Creat Moyel damond this theren told of? The sanwer is, the Creat Moyel damond this theren told of? The sanwer is, the creat the contract of the sanwer is, the contract of t diamond figured by Tavernier. I do not assert it to be the Great Mogul I assert merely that it probably is that great diamond, and I hope that in what has



Darva a Nur

been said in the cruzicims I have here offered upon the writers on the Kohi-Nur I have severed nothing that does not real ported by reasonable probability, and that I have made no avasid on any theory or fact asserted to be such by other, whoch at least offering some justification for my critic m in A true hustory of the Kohi Nur has still to be written I have I have not the control of the Kohi Nur has still to be written I

way for the writer of it. Other avocations and duties may pre-vent my undertaking the interesting task. At any rate, if it should ever be mane to perform it, I trust the result will at least bear some verisimilitude to a true history.

N. Story Maskelyne,

SCIENTIFIC SERIALS

A LAKER portion of the number of the Betanistical Gaussia for the Company of the

THE numbers of the Fenrual of Bolany for August and September contain the conclusion of Mr. G. Murray's important September contain the conclusion of Nr. U. Murray's important paper on the Algae of the Clyde searces, accompanied by a map showing the vanous depths. This page rat has now been issued separately. In his notes on Myectoos, Mr. A. Lister describes species found in various therbaria not incided in Dr. Cooke's "Mysomycates of Great Britain"—three of them new The paper is illustrated by five plates. Three new British species of Hierarium are described by Mr. E. F. Linton and species of Hieraria Mr W. H. Boeby.

SOCIETIES AND ACADEMIES.

SYDNEY.

Royal Society of New South Wales, August 5.—H.
C. Russell, F.R.S., President, in the chair.—On the microscople structure of Australian rocks, by Rev. J. Milne Curran. scopic structure of Australian rocks, by New). Miline Curran.— The Chairman presented the Society's bronze medal and a money prize of £25, which had been awarded to Father Curran for this paper.—Prof Anderson Stuart exhibited his new instru-ment for demonstrating the nature of such waves as those of

August 10—H. O. Walker, in the chair.—Notes on slicing rocks for migroscopic study, by Rev. J. Milne Curran, illustrated by rock sections in various stages of preparation for

mounting.

August 12.—C. W. Darley, in the chair —Methods of determining the stresses in braced structures, by J. I. Haycroft.

Academy of Sciences, September 28.—M Duchatre in the chair. "Notice of the works of M P. P Boileas, by M Matthee that "Notice of the works of M P. P Boileas, by M Matthee that "Notice of the works of M P. P Boileas, by M Matthee M P. P Boileas, "Determined to figure starced, discovered at Nice Observatory on August 28 and September 1, 8, and 11, by Charlons. The positions on the dates of discovery are given, and control of the discovered of the discovered at Nice Observatory on August 28 and 11, by M. Agraconet. "On the Charlon between the undex of refraction of a body, its density, molecular weight, and dusthermancy, by M. Aymonet.—On the cyclone of August 18, at Matthems, by M. G. Tissandler.

Retterte

Academy of Sciences, August 1.—M. Platesa in the chair —On the predominance and extension of Upper Econe deposits in the region between the Seene and the Diple, by M. Michal Mourion.—Direct synthesis of primary alcohola, by Dr. Michal Mourion.—Direct synthesis of primary alcohola, by Prof. Cl. Serviai.—On the curvature of lines of the order possessing a unlutiple polici of the order p. 1, by M. A. Demonitine —The order of the order possessing a unlutiple polici of the order p. 1, by M. A. Demonitine — the order of the order primary to the order primary alcohola prima The author describes a new Certaminus from the Red Sea, and manes it Certamidate brackpoinus. He has also studied in detail the tentacles of Certamidate membranaceus, and the variations of these organs during successive stages of individual evolution, and relates an interesting case of regeneration observed in Astrodate adjunitaris—Researches on the lower organisms, by M. Ican Massart.

Royal Scientific Society .- The Nachrichten from Inne to August 1891 contain the following papers of scientific

June - Karl Heun, Berlin, mathematical note on the in-tegration of the equation for the motion of Gauss's bifilar

regression of the pendulum. Fr. Schilling, note on an interpretation of the formule of spherical trigonometry when complex values are assigned to the nides and angles of a spherical triangles. August – Eduard Riceke, on the molecular theory of pleso-electricity and pyroelectricity. —Tammann and W. Mersst, on electricity and pyroelectricity. —Tammann and w. Tamping of hardone in liberated from solid.

security and pyroelectricity.—Tammann and W. Mersir, on the maximum vapour tension of hydrogen liberated from solutions by metals—Tammann, the permenbility of precipitations by metals—Tammann, the permenbility of precipitations of the control of the decircular peculiarities of tormaline.—David Hilbert, the theory of algebraic invariants of forms with any humber of variables.

BOOKS, PAMPHLETS, and SERIALS RECEIVED. The Clark and the Perry (Cassell) - Food Findings, Soc. 1 W Dur-Hambert Clark and the Perry (Cassell) - Food Findings, Soc. 1 W Dur-Africa, from Arab Domination to Straight-glasic educal by R W, Murry (Stanford) - An Elemanusy Handshope on Panalow Water F. Davis (Gray (Stanford) - An Elemanusy Handshope on Panalow Water F. Davis (Gray (Potray) - Differential and Integral Cakelini 1 F. H. Miller (Farders).— Physiograph 7 I. Spance (Panalow).—Goodesy 1 J. H. Gove (Reiners).—

Electrodry and Magnetism A Quillenist renelized by Prof. 8.
Thompson (Manufach Annaise de l'Oberyande Manufach et les touris, rice (Paris, Gambers Villent)—Some for Building and Dedrend for Prof. 8.
The Marie (New York, Wayer)—Take and Dedrend (New York Wayer)—Take Annail Reper (The Prof. 1988)—The Man of Gamss - Prof. C. Lomisons (South – Nicht Annail Reper of the Haver) Board of Sociologia (The Wayer)—The Manufach (New York Wayer)—The Manufach (New Y

DIARY OF SOCIETIES.

THURSDAY, OCTOBER & CAMERA CLUS, at 8 30 -Paper by Captain Abney. MONDAY, OCTOBRE 18.

CAMERA CLUB, at 8.30.-Lantern Evening THURSDAY, OCTORER 15 CAMERA CLUB, at 5 20.-Bacteria Photographed: Andrew Pringle-

CONTENTS. PAGE The Ice Age in North America, By Prof. T. G. The Total Reflectometer and the Refractometer for Chemists, By G. T. P. A Weather Record of the Fourteenth Century, By Our Book Shelf :-Johnston-Lavis: "The South Italian Volcanoes" . . 520 St Clair "Buried Cities and Bible Countries" , . 540 Durham "Food, Physiology, &c.". 540 "Blackie's Science Readers" 540 Letters to the Editor :-Comparative Palarability.-E. B. Titchener . . . 540 Alum Solution.-Ch. Ed. Guillaume 540 Weather Cycles.-Prof. J. P O'Reilly 541 Occurrence of the Ringed Snake in the Sea .- J. Cowper 541 A Rare Phenomenon -Herbert Rix; Dr. J. L. E.

The Heights of Auroras .- T. W. Backhouse . , . 541 Some Notes on the Frankfort International Electrical Exhibition, III. (Illustrated.) 542 On Van der Waals's Treatment of Laplace's Pressure in the Virial Equation . in Answer to

Lord Rayleigh. By Prof. P. G. Tait. 546 The Existing Schools of Science and Art, By Oliver S. Dawson 547

Our Astronomical Column:-Physical Appearance of Periodic Comets 551

Discovery of Tempel-Swift's Comet 551 Photographic Definition, I. (Illustrated.) By A.

The Koh-i-Nur-a Criticism. (Illustrated.) By Prof. N. Story-Maskelyne, F.R.S. 555 Scientific Serials 559

Societies and Academies Books, Pamphiets, and Serials Received 560 Diary of Societies 560

NO. 1145, VOL. 44]

THURSDAY, OCTOBER 15, 1801.

PHYSICAL CHEMISTRY.

Outlines of General Chemistry. By Wilhelm Ostwald Translated with the Author's sanction by James Walker, D.Sc., Ph.D. Pp. 396. (London: Macmillan and Co, 1800.)

TiAT much may be gained by a judicious use of the methods of the physicist in elucidating chemical phenomena most chemists will admit; and, considering the rapids strictles made of late years in physical chemistry, it seems surprising that so little has been done to give a connected account, suited to the wants of the student, of the main researches in this important field of investigation. Original communications on physical chemistry are on the increase. The chemist has now, in the Zeitsinry to this branch of his science, and during the four years or so of the existence of his journal, its success has testified amply to the ward which it supplies.

Ready access to original memoirs is not, however, the boon of the ordinary student; and, even if it were otherwise, the want of some scheme whereby to systematize his reading and classify his information, much of which is still open to wide difference of opinion, would almost

invariably lead to confusion

The majority of the test-books make little or no attempt at supplying this want. Occasionally a few of the larger chemical treatises spare a few pages to "physical methods," and such test-books as Meyr's "Modernen Theorien" or Murr's "Principles of Chemistry" contain much of the matter classed under physical chemistry.

Yet a comprehensive idea of what has been done in tracing relationships between physical properties and chemical composition and in utilizing physical measurements in investigating chemical change, cannot be obtained from most text-books Indeed, so far as we know, only one is designed to serve this purpose, and that is the "Lehrbuch der Allgemeinen Chemie" of Prof Catwald "Allgemeinen" rather than "Physicalische" "Chemie" has been used as a title for the work; but in the main it-deals with physical chemistry. The book the main it-deals with physical chemistry. The book can be also should be sufficiently and a server at for no other reason than that it furnishes a well-conceived vallabus of the subject-matter of general and physical chemistry, it would be worthy of careful consideration.

The book is divided into two parts-Part I. chemical laws of mass; Part II, chemical laws of energy

The first part opens with stoochometry. The laws of chemical combination, the determination of atomic weights, and a useful summary of the atomic weights, and a useful summary of the atomic weight restinations of the different elements are here given. Then follow sections treating of such of the physical properties of gases, of liquids, of solutions, and of solutions are the chemister must be familiar with, and of the more important relations which have been established between such physical properties and chemical composition.

The section dealing with solutions is noteworthy as containing the first fairly complete statement, in an Eng-

lish text-book, of the facts grouped around the physical theory of solution which has arisen out of a knowledge of osmotic pressure. Part I. closes with chapters on chemical systematics—the choice of atomic weights, the periodic law, the development of the present conception of molecular structure.

In the earlier portions of the second part, thermochemistry, photo-chemistry, and electro-chemistry are discussed. The last takes up the constitution of electrolytes, electric conductivity, and the Arrhenius

dissociation hypothesis

Chemical dynamics and chemical affinity are treated in the last two sections, and afford many illustrations of other use of physical methods in the study of chemical change. In the case of acids competing for the same hase are found instances where physical methods alone hase are found instances where physical methods alone chemical action. In these sections, the exposition of the chemical action. In these sections, the exposition of the chemical action, and of the velocity of chemical law of mass action, and of the velocity of chemical issuipect, the discussion of affinity is here more complete than in the "Lehrbuch," and however unsatisfactory the notion of fixing specific affinity constants be considered, the account set out is the most systematic and plausible yet published.

There is no doubt that the general conception of the book is admirable; it contains much that is new, to the advanced reader it will be refreshing after the time-honoured methods of the ordinary text-books. Yet the general impression which we think will be formed on looking through it, is that the attempt made to compress information into too small a compass has detracted much from its value.

A certain amount of detail is always necessary to incitilgent competension, and in many parts of the book there is too much bald statement to satisfy the reader who approaches the subject for the first time. Manly for this reason it is a question whether the work will answer the expectation of the author that; will "meet end have the requirements of the student who, while not intending not to devote himself to the detailed study of general chemistry, still wishes to follow untelligently the progressor the property of the progression of the progression

The time which has been spent in preparing the chapters on several important topics seems to have been madequate For instance, the molecular volumes of liquids are disposed of in little more than three pages. Kopp's laws are quoted, although not one of them can now be taken as valid, Schiff's inaccurate rule as to the volumes of isomers also finds a place. Instead of apparently settling the question by stating " molecular volumes to be additive magnitudes subject to constitutive influence," little more space would have been occupied in showing how, in different groups of isomers, the volume varies with the constitution. If recent progress on the subject was to be made use of the facts that the effects of molecular weight and constitution cannot be disentangled, that even from the comparison of compounds of similar constitution, definite atomic volumes, determined for the boiling-point, cannot be obtained-that, in short, atomic volumes cannot be regarded as physical constants -ought surely to have been emphasized.

The desire to economize space is probably the cause

of several examples of rather mixed information The following paragraph occurs on p. 104:-

"Ordinary destrolarance acid, for instance, has precisely the sum's properties a Bevoatratine acid; but the compound of both which crystallies from their mixed solutions on exporation—receime acid—has quite a different character. The first-named crystallies analydrous, the last hydrated. The simple acids do not precipitate a solution of calcium sulphate. The compleased that is such difference only occur with solid compounds, race nic acid behaves in solution like a mirrare of the two components.

Seeing that this book is one of the very few in which Vander Waalis's work obtains the prominence which it deserves, and which has been long delayed, it seems a pity that pains have not been taken to make the account securate.

On p 67 the reader is led to infer that θ in Van der Wash's equation is the volume of the molecules; the true value of θ is four times the volume of the molecules, Again, on p 90, it is stated that the equation "is deduced only for the case where the volume of the substance is eight times as large as the magnitude θ ", correctly given, this should be, 'is deduced for cases where the volume is greater than 2θ " is

Admirable as may be the exposition of the theory of solution from the advanced standpoint here taken up, it may rightly be questioned whether the student is fairly treated The physical theory of solution, the dissociation hypothesis, no one knows better than the author, are still strongly contested should the student therefore not have heard a little more of the other side of the question? Particularly objectionable is the application of such terms as Boyle's law, Gay Lussac's law, &c., to solutions In the opening chapters of the book the reader is familiarized with the kinetic theory of gases, he is enabled to form a mental picture of the mechanism which results in the pressure of a gas How he, or, indeed, anyone, can form a similar picture for a solution, when the molecules of the solvent have also to be taken into consideration, it is difficult to imagine. By using for solutions a term such as Boyle's law, which for gases is capable of a perfectly definite interpretation, the real difficulty of the question is ignored, and misconception is almost sure to arise, especially in the case of the beginner

We noticed in passing that, on p 364, polybasic is used for dibbasic, on p 376, $A_0 = k_p^2 k^2$ should be $k_p = k_p^2 k$. Frequently there is no distinction between the type of letters occurring in formulae, and that in which the book is printed Reference in the body of the book to portions of formulae is therefore apt to lead to confusion, and in any case lacks clearness, as may be seen on pp. 879 and 369

The work, from its very title, apart even from the reputation of the author, will no doubt appeal to a large class of readers, as an English text-book of chemissry it is unique. We venture to think, however, that if such points as those indicated were attended to, particularly the question of space, its sphere of usefulness would be materially enlarged

' Physical Society Memours, i. 3, 452 NO. 1146, VOL. 44

UNITED STATES FISH COMMISSION REPORTS

Bulletin of the United States Fish Commission. Vol. VIII for 1888. (Washington, 1890.)

IN 1881 the benate and House of Representatives of the United States of America authorized the public territor to print from time to time any matter furnished to him by the United States. Commissioner of Fish and Fisheries relative to new observations, discoveries, and applications connected with his culture and the fisheries. The printed matter was to be capable of being distributed in parts, the whole was to form an annual volume or Bulletin not exceeding 500 pages, and the edition was to be limited to 5000 copies.

Seven volumes of this important series have since been published, and have been noticed in our pages. They were composed chiefly of translations or republications of articles on fish of fisheries which had appeared in European periodicals or as State documents; extracts from and official correspondence, with statistics of work done; and often of short articles of direct scientific interest on American fish, the whole forming a most valuable, practical encyclopadia of everything relating to the economic study of fish

An eighth volume, dated 1800, but being the Bulletin for 1888, has just been issued from the Washington Press The increased operations of the United States Fish Commission during 1888 have made it possible to devote almost the whole of this volume to the results of the work of the Commission, and it will be found to contain matter of considerable interest. The size of the volume has been slightly enlarged, so as to afford room for larger illustrations.

Of the twelve memoirs or papers contained in this volume, five relate to local collections of fishes Mr Parleton II Bean gives notes on a collection made at Cozumel. Yucatan, sixty species are enumerated; two new species are described and figured. Mr. C. H. Bollman reports on the fishes of Kalamazoo, Calhoun, and Antrim counties in Michigan Mr S A. Forbes contributes a preliminary account of the invertebrate animals inhabiting Lakes Geneva and Mendota, in Wisconsin, and gives some particulars of the fish epidemic in the latter lake in 1884 Mr. C H. Gilbert describes some fish from the lowlands of Georgia Mr D S. Jordan gives a report of explorations made during 1888 in the Alleghany region of Virginia, North Carolina, and Tennessee, and in Western Indiana, with an account of the fishes found in each of the river-basins of those regions.

In a review of the genera and species of Serrandie, by S. Jordan and C. H. Eigenmann, we have an enumeration of all the genera and species belonging to this family found in the waters of America and Europe, together with the synonymy of each, and analytical keys by which the different groups may be distinguished. One hundred and nunteen species are admitted, and thirty-four genera. This memori is illustrated with the plates. Mr. J. W. Collins contributes a paper on improved types of vessels for use in the market fisheries, with some notes on British fishing-steamers, and Mr. W. F. Page gives an account of the most recent methods of hatching fishings.

bility of introducing the mountain mullets of Jamaica (Agonostoma) into some of the Alpine streams of the Southern States; and Mr. R. Rathbun gives a detailed report on the introduction of lobsters to the Pacific shores of the United States.

The two most important contributions to this volume are, however, those by Lieutenant Tanner, "On the Result of the Explorations of the Fishing-grounds of Alaska, Washington Territory, and Oregon during 1888," and by Mr. John A. Ryder, "On the Sturgeons and Sturgeon Industries of the Eastern Coast of the United States,"

Although it had been known for many years that the Pacific coasts of North America were abundantly provided with edible fishes, it was not until 1880 that the exact species of these were correctly determined, the Alaskan cod proving to be the same species as that of the North Atlantic. The absence of large and convenient markets hindered the development of the Pacific coast fisheries; but, with the completion of the railroad system. this state of things has changed, and a strong interest is now being shown in all that relates to the development of the fish industry. This Report affords us the first accurate information that has been obtained respecting most of the fishing-grounds in Alaska. The five banks whose positions were indicated by older surveys-namely. Davidson, Sannakh, Shumagin, Albatross, and Portlock banks-were more thoroughly examined than were the entervening areas, some of which, however, may, upon further examination, prove to contain fishing-banks of equal value, and not inferior in size, to at least the smaller of the banks mentioned

Good fishing was obtained at nearly all localities where rada were made with hand-lines, whether upon defined banks or upon the more level grounds between them, and not set seems natural to infer that the entire submerged plateau erform off Unalashka Island to Fairweather Ground is one mimense fishing-bank, limited upon the outer side only by the abrupt slope, which may be said to begin about the 100-fathom curve

Although the great bulk of this Report relates to the fishing-banks and fishes, yet we get various glimpses of many interesting facts relating to other of the vertebrate and to many of the invertebrate forms met with Off Popolf Island, large masses of sea-urchins, star-fishes, and large Medusæ were found in the scine nets, and the hooks became entangled with fine specimens of sea pens (Pennatula) At the Lighthouse Rocks a landing was in ide, to examine a large rookery of Steller's sea-lion (Eumetopias stellers). Several hundreds of these animals were found crowded together upon a very limited area. As the party landed, the old sca-lions came tumbling down over the rocks in great eagerness to reach the sea; a few. whose retreat was intercepted, were seen to jump from their high positions directly into the water, apparently sustaining no injury from the plunge, although the distance was considerable, especially for such large animals A couple of killer whales (Orca), attracted by the disturbance and the sight of so many seals in the water, came quite close to the rocks, causing the seals to gather nearer the shore, and to cast frightened looks of alarm towards the whales, whose dorsal fins showed not less than four feet above the surface of the water. These rocks

were entirely destitute of vegetation Off Trinity Islands, large quantities of crustaceans, worms, mollusks, echinoderms, and sponges were taken—an especial feature of the hale consisting of over a hundred specimens of a fine large free crinoid. As all these specimens will find their way to the United States National Museum, we may expect soon to have recorded many additions to the manne fauna of the North Pacific.

Mr. John A. Ryder's paper will also be perused with great interest. Having undertaken to report on the sturgeons and sturgeon fisheries of the eastern rivers of the United States, he repaired in May 1888 to Delaware City. which is described as a very important centre of the sturgeon fishery Two species of the genus Acipenser are to be found in the waters along the Atlantic coast of the United States, these are A sturio, 1., and A brevirestris. Le Sueur The former (the common sturgeon) is the only one of any commercial importance at Delaware, as Le Sueur's species is so rare that only five specimens of it were taken by Mr. Ryder, and since the date of its first being described, in 1817, it does not appear to have been until now again recognized Of the other American species, one is the very distinct fresh-water sturgeon of the Lake region, and two others are to be found on the Pacific coast

The embryological data of this memoir have been in a good measure drawn from the author's original investigations, but he has fortunately also given us in addition details from the writings of Balfour, Knoch, Parker, Lograff, and Salensky He found it perfectly practicable to fertilize artificially the sturgeon's roe, and thinks it possible that millions of young sturgeon might be developed in this way He treats in detail of the dermal armature of the sturgeon's body, illustrating this part of his subject by numerous photogravures, describes the organs of locomotion, the lateral line system, the viscera, and lymphatics The sources of the food of this fish and its peculiar habits are next considered, and special information is given about the preparing of the flesh for market. and the manufacture of the caviace. A very useful bibliography of the literature relating to the sturgeon is appended. This memoir is illustrated by twenty-two plates.

THE CATALOGUE OF THE WASHINGTON MEDICAL LIBRARY

Index Catalogue of the Library of the Surgeon-General's Office, US Army Vol XI Phiedronus--Régent Pp 1102 (Washington, 1890)

THE appearance of these very fine folios year by year for the last eleven year: is a very good proof to all lovers of books and collecturus of books in Europe that they have some sympathetic frends in America who have the will and the power to make one at least of their finest libraries well known throughout the world. Its title as the Library of the Surgeon-General's Office may once have sounded little the name of a collection of musty Blue books title together with Mr. J. S. Blulings, which we feet constantly in the monthly publication of the Index Heditury, everyone knows now that it is nothing of the kind, but

one of the first medical libraries, if not the first, in the world, containing much more medical literature than is to be found in the libraries of the richer English corporations, the Royal Colleges of Physicians and Surgeons, or of the more learned and active Societies, such as the Royal Medical and Chururgical Society, or, Indeed, in the British Museum or Bibliothèque Nationale. And though the Washington Library is of comparatively recent date, going back only some thirty years, yet it contains a very fine collection of books both of the fifteenth and sixteenth centuries; and at the same time the great difficulty of the maker of a catalogue to a modern library, viz. the immense mass of the newspaper and periodical literature of to-day, has been fairly faced and overcome. During the past year, 287 periodicals have been added to the list of those that are taken in raising the total number to about 7500, of which at least 3000 are current. The vast aggregate of articles in these are duly catalogued, each under the head of its subject-matter. It is not surprising, therefore, that we should find 80 of these large square folio pages filled in the present volume with entries under the heading Phthisis, 78 under Puerperal Diseases, 67 under Pregnancy, and 56 under Pneumonia. Even as devoted entirely to a lesser matter like the pulse, there are catalogued 150 volumes and 350 articles in periodicals. The care with which the records of the smallest steps in the past history of medicine have been preserved is shown by the accumulation of twenty-five editions of the "Pharmacopæia" of the Royal College of Physicians of London from the years 1657 to 1851. Under such headings as Psychology, we may see the wide range also of the larger subjects embraced in the Library, for the collection under this heading begins with many expositions of Aristotle, and does not neglect Plato, but takes in also the recent books of modern authors, such as the last edition of Herbert Spencer's " Principles of Psychology" and Taine's "De l'Intelligence" The eleventh volume of this magnificent catalogue brings us to within measurable distance of the end; from the analogy of lesser works, in fact, it seems probable it may be completed in three or at most four volumes, and it will then be a great monument among modern catalogues, and in its articles under subject titles form a most valuable dictionary to all who are seeking a clue to the complete historical study of medicine and surgery A T. MYERS.

OUR BOOK SHELF

Dictionary of Political Economy. Edited by R. Inglis Palgrave, F.R S. Part I. Abatement—B (London . Macmillan and Co., 1891.) Abatement-Bede.

THIS is a first instalment of what promises to be a very THIS is a first instalment of what promises to be a very valuable addition to the Linglish library of political economy. The plan of the work is laid down on broad lines, and includes not only articles dealing with strictly economic subjects, and explanations of legal and business terms, but good (though necessarily brief) accounts of historical events bearing on economic history, such as the exhabilament and downful of the additors antionaux? In Paris in 1848, and biographical notices of deceased writers whose life and work has had any connection with the development of economic theory or practice. That the biographical section of the dictionary is conceived in a liberal spirit is sufficiently proved by the fact that the first part, now under review, includes notices of Addison and

Thomas Aquinas; the claim of the former to a place in a dictionary of political economy is based in the main on the fact that he held an official position in the Government of his time as one of the Lords Commissioners of Trade. This rather remote connection with economics may be open to criticism, and it remains to be seen whether Mr. Palgrave will include in his dictionary the honoured names of William Wordsworth and Robert Burns. It is not, however, desirable to say anything in the way of criticism which should tend to narrow the scope of the work. Its interest and vitality depend, to a large degree, on its broad inclusiveness.

The biographical articles are particularly well done, and we would single out that on the late Mr. Bagehot for special commendation It gives not only the dry facts of his career, but presents a living picture of a peculiarly fascinating personality, and also a very just estimate of his place in, and services to, economic literature. Among the prace in, and services to, economic iterature. Among the most important articles in the present installment of the dictionary may be mentioned that on agricultural communities, by Prof. J. S. Nicholson, and that on banks. The former gives an admirable summary of the conditions. of life in existing village communities in Russia and India, and also a digest of the results arrived at by the researches of Sir Henry Maine, Mr Seebohm, and M. de Laveleye, as to the existence of various forms of village communities in the remote past in our own and other countries. The article on banks gives an historical sketch of the development of banking in various countries, contributed by different writers, each with special knowledge of his own portion of the subject. Thus we have brought together within the compass of a few pages an account of the land banks and the Schulze Delitsch credit banks of Germany, the savings banks (trustee and Post-office) of England, and the popular banks of Italy

The names of the contributors to the present volume.

and also those who have promised their assistance in the preparation of the rest of the work, are a guarantee of its high value to all students of social and economical subjects.

South Africa, from Arab Domination to British Rule Edited by R. W. Murray, F R.G S. With Maps, &c. (London: Edward Stanford, 1891.)

ONE of the objects of this book is to bring out the con-ONE of the objects of this book is to bring out the contrast between Portuguese rule in South Africa and the influence exerted by England. The contrast is certainly striking enough; and it is shown most clearly, as in the present work, by a simple statement of historic facts. In the first chapter. Prof. Keane sketches the career of the Portuguese in the various South African regions they have dominated. This is followed by translations they have dominated. This is followed by translations from the "Africa of Dapper, a Dutch writer of the seventeenth century, showing that at that time the Portuguese stationed on the African coasts made no effort to acquire extensive the African coasts made no effort to acquire extensive knowledge of the interior. The editor then records the main facts relating to the Dutch and English settlements in the south, and the recent movements northward to Bechuanaland, Matabeleland, and Mashonaland. Mr. J. W. Ellerton Fry, late of the Royal Observatory, Cape Town, Lieutenant of the British South African Company's expeditionary force, gives an account of what he himself observed during the march into Mashonaland in 1800; and much information with regard to the east coast of Africa at Beira, Pungwe, and the Zambesi is presented in notes from the diary and correspondence of Mr. Neville H. Davia late surveyer and budgerages. dr. Neville H. Davis, late surveyor and hydrographer to the Queensland Government, who, in 1890, accompanied an expedition sent to East Africa to discover whether an expection sent to Last Airica to discover waterner there was any mineral or other wealth in concessions granted by the Morambique Company. The book has not been very systematically planned; but it brings together so many facts which are not readily accessible elsewhere, that it cannot fail to interest readers whose

attention is for any reason especially directed to South Africa. It includes several excellent maps, and two engravings of Cape Town, showing Cape Town as it was in 1668, and as it is in 1891.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinsons ex-pressed by his correspondents, Nather can he undertake manuscripts intended for this or any other part of NATURE.

No notice is taken of anonymous communications.

A Pink Marine Micro-organism.

A Fink Marina Micro-organiam.

Whitz dreign interju Luck-Fron I nuticed through the clear water, in a bittle shallow bay on the north sade of the clear water, in a bittle shallow bay on the north sade of the clear water, in a bittle shallow bay on the north sade of the clear through the sade was been considered by a sading from a boat spots, about a foot in diameter, where the clear white sand was discoloured, most of the surface grains being almost exactly the Under a low power of the moreopoe, it is seen that the purk particles are ordinary clear quarts sand-grains, increased with like bright just pagin spanse, parentally of elongated or assuage-intelligent through the same of the same shall be said to be sufficiently as the same shall be said to tigate this one. W. University College, Liverpool, October 6.

Advertisements for Instructors.

THE friends of technical education can no longer complain

The friends of technical education can no longer compliant that the subject is not receiving attention. The numerous advertisements for instructors of all sorts, from County Councils and other boties, colleges and schools are full redence that Whether all the plans and proposals and experiments will lead to the hope-for results only time will show. Some of us have out doubts as regards many of them. Meantline, one of the advertisements is meared of "a demonstrator in the Metallurgical Department to take the lectures in geology and inherology, and to give instruction in dry assaying and in iron and steel analysis" (see NATURE This is extrainty a large and considerable mixed "Onle".

of this week). This is certainly a large and considerably mixed "order," calculated to make thoughtful people wonder what sort of insertaction is expected to be given by this glitch person (who as the property of the prope

"Rain-making."

ITHINK the following will be of interest to your readers to connection with the "min-making" experiments in Texas. Connection with the "min-making" experiments in Texas. The connection will be a single beat with the Pennyh sate quarties in order to clear anyly a very large miss of useless rock. A stong with had the anyly a very large miss of useless rock. A stong with had been been been on the properties with the properties with the properties was consended in the minimum of the termination was consended in the connection of the properties of the connection of the properties of the properties

NO. 1146, VOL. 447

which lasted about 5 or 6 minutes, and 20 minutes later a fine rain began to fall, which soon became heavy and continued for an hour staff a half. By 7 nm all disturbances produced by a fine and the staff and the

Alum Solution.

With reference to the question raised by Mr. H. N. Draper in NATURE, vol. alv p. 4,6, as to the practical appearontly of an alam solution over ample where in absorbing such radiations are almost than the such as the property of the proper

Solutions, &c Empty cell Water dutilled Diathermance

197 Water from tap 200 Alum, saturated solution

It is clear therefore that, at least under conditions like those It is clear therefore that, at least under conditions like those of my experiment, plain water will answer the purpose of an absorbent rather better than an alum solution. Possibly the "alum cell" tradition rests upon no better foundation than many others, which are generally accepted simply because it does not occur to people to question them.

October to

SHELFORD BIDWELL.

B.Sc. Exam. Lond. Univ. 1802.

THERE are, I believe, in London at the present time a number of men desirous of offering geology as one of three subjects required at the Degree Examination in Science, but who are deterred from so doing by the fact that it is impossible to

but an adoquate evening class tuition in this subject
Enquires at the various teaching institutions have failed to

Enquires at the various teaching institutions have failed to discover a single opportunity for working up to the required smader in both theoretical and practical branches. King's College, Strand, with the result that he has very kindly consented, in the event of enough men requiring it, to supplies ment his lectures on geology and mineralogy by a course of in-mental properties of the control of the control of the highest properties of the control of the control of the by gring publicity to the matter, it is hoped that a sufficient number of B.Sc. candidates will be forthcoming to ensure the exclusionated of this class.

The time-table for the complete course will be as follows :-

Monday Petrology 6-7 p.m. Muneralogy 7-8 "Geology 8-9 "

The lectures and practical work, oggether with the aumore from the practical work, oggether with the aumore from the practical work, oggether with the aumore from the practical practical property of the presented from attending day courses, and will undoubtedly severe admanable preparation for the examination specified. From suppose interested in the matter, on the arrangements may at once he made for the first aitting to take place on Monday, October 19.

EDWARD J. BURKELL.

People's Palace, Mile End Road, E.

Some Notes.

Those who have visited Venuce in spring know how rampant mosquitoes become after the flight of the awallows, which have kept them as cheek, for the north—unauly in May. A word for the sparrows—which have been very active in the gradent benefouls this season, praying on the green files and larve infesting the creepers and ferns in particular; but were allowed to the great files and larve infesting the creepers and ferns in particular; but were warnings have been observed, to the great increase of earth-

worms in the lawns The crane-fly, which usually swarms in the fields of the Mansfield estate in September, has been very rare, too, this season. The dragon-fly visited us this summer for the first time

r the first time.

Apropos to the records of the "rare phenomenon," such a mmer aurora was observed at Rothbury, Northumberland, in the latter half of August 1880

the inter nail of August 1880
To conclude this farrago of notes for "non pas travaille," in
Mr Sclater's quotation of the Prince of Canino's words (xliv
p 518), read "nost ."
J J. WALKER.
Hampstead, N W, October 3.

THE MOLECULAR PROCESS IN MAGNETIC

M AGNETIC induction is the name given by Faraday to the act of becoming magnetized, which certain substances perform when they are placed in a magnetic field. A magnetic field is the region near a magnet, or conveying an electric current. Throughto the act of becoming magnetized, which certain near a conductor conveying an electric current out such a region there is what is called magnetic force, and when certain substances are placed in the magnetic field the magnetic force causes them to become magnetized by magnetic induction. An effective way of producing a magnagieste induction. An energive way or producing a mag-netic field is to wind a conducting wire into a coil, and pass a current through the wire. Within the coil we have a region of comparatively strong magnetic force, and when a piece of iron is placed there it may be strongly mag-netized. Not all substances possess this property. Put a piece of wood or stone or copper or silver into the field, and nothing noteworthy happens, but put a piece of iron or nickel or cobalt and at once you find that the piece has become a magnet These three metals, with some of their alloys and compounds, stand out from all other substances and the respect Not only are they capable of magnetic induction—of becoming magnets while exposed to the action of the magnetic field—but when withdrawn from the field they are found to retain a part of the magnetism they acquired Thev all show this property of retentiveness, more or less In some of them this residual magnetism removed without difficulty In others, notably in some removed without uniterity in others, notably in sorted, it is every persistent, and the fact is taken advantage of in the manufacture of permanent magnets, which are simply bars of steel, of proper quality, which have been subjected to the action of a strong magnetic field. Of all substances, soft iron is the most susceptible to the action of the field lt can also, under favourable conditions, retain, when taken out of the field, a very large fraction of the magnetism that has been induced-more than ninetenths—more, indeed, than is retained by steel, but its hold of this residual magnetism is not firm, and for that hold of this resinual magnetism is not firm, and for that reason it will not serve as a material for permanent magnets. My purpose to-night is to give some account of the molecular process through which we may conceive magnetic induction to take place, and of the structure which makes residual magnetism possible.

When a piece of iron or nickel or cobalt is magnetized

by induction, the magnetic state permeates the whole piece. It is not a superficial change of state. Break the piece. It is not a supernous change of state. Dreak the piece into as many fragments as you please, and you will find that every one of these is a magnet. In seeking an explanation of magnetic quality we must penetrate the innermost framework of the substance—we must go to the molecules

the molecules

Now, in a molecular theory of magnetism there are
two possible beginnings. We might suppose, with

Poisson, that each molecule becomes magnetized when
the field begins to act. Or we may adopt the theory of

Weber, which says that the molecules of iron are always
magnets, and that what the field does is to turn them so

Abstract of a Friday Evening Discourse delivered at the Royal Institution on May 22, 1821, by J. A. Ewing, M.A., F.R.S., Professor of Apple Mechanics and Mechanism in the University of Cambridge

NO. 1146. VOL. 447

that they face more or less one way. According to this view, a virgin piece of iron shows no magnetic polarity, not because its molecules are not magnets, but because they lie so thoroughly higgledy-piggledy as regards direc-tion that no greater number point one way than another. But when the magnetic force of the field begins to act, the molecules turn in response to it, and so a prepon-derating number come to face in the direction in which the magnetic force is applied, the result of which is that I may mention at once—it is almost conclusive in itself. When the molecular magnets are all turned to face one when the molecular imagnets are all turner, to save out way, the piece has clearly received as much magnetization as it is capable of Accordingly, if Weber's theory be true, we must expect to find that in a very strong magnetic field a piece of iron or other magnetizable metal becomes saturated, as that it cannot take up any more magnetism, however much the field be strengthened This is just what happens experiments were published a few years ago which put the fact of saturation beyond a doubt, and gave values of the limit to which the intensity of magnetization may be forced.

of magnetization may be forced.
When a piece of iron is put in a magnetic field, we do not find that it becomes saturated unless the field is exceedingly storing. A weak field induces but little magnetism; and if the field be strengthened, more and more magnetism is acquired. This shows that it molecules do not turn with perfect readiness in response. turning is in some way resisted, and this resistance is overcome as the field is strengthened, so that the magnetism of the piece increases step by step. What is the directing force which prevents the molecules from at once yielding to the deflecting influence of the field, and to what is that force due? And again, how comes it that after they have been deflected they return partially, but by no means wholly, to their original places when the field ceases to act?

I think these questions receive a complete and saiisfactory answer when we take account of the forces which the molecules nece sarily exert on one another in consequence of the fact that they are magnets. We shall study the matter by examining the behaviour of groups of little magnets, pivoted like compass needles, so that

of little magnets, pivoted like compass needles, so that each is free to turn except for the constraint which each one suffers on account of the presence of its neighbours, when a piece of iron or steel or nickel or cobalt is mag-netized by means of a field the strength of which is gradually augmented from nothing. We may make the experiment by placing a piece of iron in a coil, and making a current flow in the coil will gradually increased strength, noting at each stage the relation of the induced magnetism to the strength of the field. This relation is observed to be by no means a simple one: it may be observed to de of on means a simple one: it may be represented by a curve (Fig. 1), and an inspection of the curve will show that the process is divisible, broadly, into three tolerably distinct stages in the first stage (a) the magnetism is being acquired but slowly: the molecules, if we accept Weber's theory, are not responding readily—they are rather hard to turn. In the second stage (b) their resistance to turning has to a great extent broken down, and the piece is gaining magnetism fast. In the third stage (c) the rate of increment of magnetism falls off: we are there approaching the condition of satura-tion, though the process is still a good way from being completed.

Further, if we stop at any point of the process, such as Further, it we stop at any point of the process, same as p, and gradually reduce the current in the coil until there is no current, and therefore no magnetic field, we shall get a curve like the dotted line PQ, the height of Q showing the amount of the residual magnetism.

If we make this experiment at a point in the first stage

(a), we shall find, as Lord Rayleigh has shown, little or no residual magnetism : if we make it at any point in the second stage (b), we shall find very much residual magnetism; and if we make it at any point in the third stage (c), we shall find only a little more residual magnetism than we should have found by making the experiment at the end of stage b. That part of the turning of the at the end of stage a. That part of the tanning of the molecules which goes on in stage a contributes nothing to the residual magnetism. That part which goes on in stage c contributes little. But that part of the turning which goes on in stage \(\delta \) contributes very much in some specimens of magnetic metal we find a much



sharper separation of the three stages than in others By applying strain in certain ways it is possible to get the stages very clearly separated. Fig 2, a beautiful instance of that, is taken from a paper by Mr Nagaoka -one of an able band of Japanese workers who are bidding fair to repay the debt that Japan owes for its learning to the West. It shows how a piece of nickel which is under the joint action of pull and twist becomes magnetized in a growing magnetic field. There the first stage is exceptionally prolonged, and the second stage is extraordinarily abrupt.



The bearing of all this on the molecular theory will be evident when we turn to these models, consisting of an assemblage of little prvoted magnets, which may be assemblage of little protect magnets, which may be taken to represent, no doubt in a very crude way, the molecular structure of a magnetizable metal 1 have beer some large model; where the protect magnetia are pieces of sheet steel, some cut mos bent if it bays, others into diamond shapes with pointed mids, other shapes shapes resembling musthrooms or means of a coll of in-ternative to the steel of the shapes when the shapes the magnetic flower or a large wooden frame below the solated wire wound on a large wooden frame below the magnets. Some of these are arranged with the pivots on

a gridiron or lazy-tongs of jointed wooden bais, so that we may readily distort them, and vary the distances of the pivots from one another, to imitate some of the effects of strain in the actual solid. But to display the experior strain in the actual solly in the display the experi-ments to a large audience a lantern model will serve best. In this one the magnets are got by taking to pieces numbers of little pocket compasses The pivots are cemented to a glass plate, through which the light passes in such a way as to project the shadows of the magnets on the screen. The magnetic force is applied by means of two coils, one on either side of the assemblage of magnets and out of the way of the light, which together produce a nearly uniform magnetic field throughout the whole group. You see this when I make manifest the



Fig 1

field in a well-known fashion, by dropping iron filings on

the plate. We shall first put a single pivoted magnet on the plate. We shall first put a single pivoted magnet on the plate is no direction it prefers to any other. As soon as I apply even a very weak field it responds, turning at once into the exact direction of the applied force, for there was nothing (beyond a trifling friction at the pivot) to prevent it from turning

Now try two magnets 1 have cut off the current, so that there is at present no field, but you see at once that the pair has, so to speak, a will of its own I may shake or disturb them as I please, but they insist on taking up a position (Fig. 3) with the north end of one as close as



possible to the south ead of the other If disturbed they return to it; this configuration is highly stable. Watch what happens when the magnetic field acts with gradually growing strength. At first, so long as the field is weak (Fig 4), there is but sittle deflection; but as the deflection (Fig. 4), there is but little deflection; but as the deflection increases at is evident that the stability is being lost, the state is getting more and more critical, until (Fig. 5) the tie that bolds them together seems is to break, and they suddenly turn, with violent swinging, into almost perfect alignment with the magnetic force it. Now I gradually remove the force, and you see that they are Jlones testing, but a stage comes when they awing back, and a

complete removal of the force brings them into the condition with which we began (Fig. 3).
If we were to picture a piece of iron as formed of a vast number of such pairs of molecular magnets, each pair far enough from its neighbours to be practically out of reach of their magnetic influence, we might deduce many of the observed magnetic properties, but not all



Frg. s

In particular, we should not be able to account for so much residual magnetism as is actually found. To get that, the molecules must make new connections when the old ones are broken; their relations are of a kind more complex than the quasi-matrimonial one which the experiment exhibits. Each molecule is a member of a larger



Fig 6

community, and has probably many neighbours close enough to affect its conduct.
We get a better idea of what happens by considering four magnets (Fig. 6). At first, in the absence of deflecting magnetic force, they group themselves in stable pairs—in one of a number of possible combinations. Then—



Fig 7

as in the former case-when magnetic force is applied, As in the former case—wenn magnetic toric is approximately and inferior in the yar at first slightly deflected, in amaner that exactly tallies with what I have called the stage a of the magnetism grocess. Next comes instability. The original ties break up, and the magnets swing violently round; but finding a new possibility of combining (Fig. 7), they take

to that. Finally, as the field is further strengthened, they are drawn into perfect alignment with the applied magnetic force (Fig. 8).

nette force (Fig. 8).
We see the same three stages in a multiform group (Figs. 9, 10, 11). At first, the group, if it is shuffled by any casual disturbance, arranges itself at random in lines that give no resultant polarity (Fig. 9). A weak force produces no more than slight quasi-slastic deflections; a stronger force breaks up the old lines, and forms new ones



Fra &

more favourably inclined to the direction of the force (Fig 10) A very strong force brings about saturation

more favourably inclined to the distribution of the first plant saturation (Fig. 11). They strong force brings about saturation (Fig. 11) an actual piece of from there are multitudes of groups fulfierently directed to begin with—perhaps also favourable the saturation of the first, and so on. Hence, the curve of magnetization does not



consist of perfectly sharp steps, but has the rounded out-lines of Fig. 1.

Notice, again, how the behaviour of these assemblages of elementary magnets agrees with what I have said about residual magnetism. If we stop strengthening the field before the first stage is passed—before any of the magnets have become unstable and have tumbled round into new places—the small deflection simply disappears, and there is no residual effect on the configuration of the group. But if we carry the process far enough to have unstable deflections, the effects of these persist when the force is removed, for the magnets then retain the new



Fig. 10.

grouping into which they have fallen (Fig. 10). And again, the quasi-elastic deflections which go on during the third stage do not add to the residual magnetism.



Fig. 11.

Notice, further, what happens to the group if after applying a magnetic force in one direction and removing it, I begin to apply force in the opposite direction. At first there is little reduction of the residual polarity, till a

stage is reached when instability begins, and then reversal occurs with a rush. We thus find a close imitation of all the features that are actually observed when iron or any of the other magnetic metals is carried through a cyclic magnetizing process (Fig. 12). The effect of any such process is to form a loop in the curve which expresses the relation of the magnetism to the magnetizing force The changes of magnetism always lag behind the changes of magnetizing force This tendency to lag behind is called magnetic hysteresis

We have a manifestation of hysteresis whenever a mag netic metal has its magnetism changed in any manner there meast any magnetism changes in any mainer through changes in the magnetizing force, unless indeed the changes are so minute as to be confined to what I have called the first stage $(a, \operatorname{Fig} 1)$ Residual magnetism is only a particular case of hysteresis

Hysteresis comes in whatever be the character or cause of the magnetic change, provided it involves such deflections on the part of the molecules as make them become unstable. The unstable movements are not reversible with respect to the agent which produces them,



Fig. 12—Cyclic reversal of magnetization in soft iron (AA), and in the same iron when hardened by stretching (as)

that is to say, they are not simply undone step by step as the agent is removed.

We know, on quite independent grounds, that when the magnetism of a piece of iron or steel is reversed, or indeed cyclically altered in any way, some work is spent indeed cyclically attered in any way, some work is spent in performing the operation—energy is being given to the iron at one stage, and is being recovered from it at another; but when the cycle is taken as a whole, there is a net loss, or rather a waste of energy. It may be shown a net loss, or rather a waite of energy. It may be shown that this waite is proportional to the area of the loop in our diagrams. This energy is dissipated; that is to say, it is to say the same of the control of the alternating current, tend to become hot for this very reason; indeed, the loss of energy which happens in it, in consequence of magnetic hysteresis, is a serious draw-back to the efficiency of alternating current systems which the control of alternating current systems of distributing electricity. It is the chief reason why they require much more coal to be burnt, for every unit of electricity sold, than direct-current systems require

The molecular theory shows how this waste of energy When the molecule becomes unstable and tumbles violently over, it oscillates and sets its neigh-bours oscillating, until the oscillations are damped out by the eddy currents of electricity which they generate in the surrounding conducting mass The useful work that can be got from the molecule as it falls over is less than the work that is done in replacing it during the return portion of the cycle. This is a simple mechanical deduction from the fact that the movement has unstable phases

I cannot attempt, in a single lecture, to do more than glance at several places where the molecular theory seems to throw a flood of light on obscure and complicated facts, as soon as we recognize that the constraint of the molecules is due to their inutual action as magnets

It has been known since the time of Gilbert that vibration greatly facilitates the process of magnetic induction. ton greatly actitates the process of magnetic induction. Let a piece of iron be briskly tapped while it lies in the magnetic field, and it is found to take up a large addition of its induced magnetism. Indeed, if we examine the successive stages of the process while the iron is kept vibrating by being tapped, we find that the first stage (a) has orating by 06 ing uppen, we into that the interaction appears that provided in the state of and rapid growth of magnetism almost from the very first. This is intelligible enough. Vibration sets the molecular magnets oscillating, and allows them to break their printive mutual ties and to respond to weak deflecting forms. For a similar reason, vibration should tend to reduce the residue of magnetism which is left when the magnetizing force is removed, and this, too, agrees with the results of observation.

Perhaps the most effective way to show the influence of vibration is to apply a weak magnetizing force first, before tapping If the force is adjusted so that it nearly but not quite reaches the limit of stage (a), a great number of the molecular magnets are, so to speak, hovering on the verge of instability, and when the piece is tapped they go over like a house of cards, and magnetism is acquired with a rush Tapping always has some effect of the same kind, even though there has been no special adjustment of the field.

And other things besides vibration will act in a similar way, precipitating the break-up of molecular groups when the ties are already strained. Change of temperature will sometimes do it, or the application or change of will sometimes do it, or the application or change of mechanical strain Suppose, for instance, that we apply pull to an iron wire while it hangs in a weak magnetic field, by making it carry a weight. The first time that we put on the weight, the magnetism of the wire at once increases, often very greatly, in consequence of the action I have just described (Fig 13) The molecules have been on the verge of turning, and the slight strain caused by the weight is enough to make them go Remove the weight, and there is only a comparatively small change in the magnetism. for the greater part of the molecular turning that was done when the weight was put on is not undone when it is taken off Reapply the weight, and you find again but little change, though there are still traces of the kind of action which the first application brought about to say, there are some groups of molecules which, though they were not broken up in the first application of the weight, yield now, because they have lost the support they then obtained from neighbours that have now entered into new combinations. Indeed, this kind of action may often be traced, always diminishing in amount, during several successive applications and removals of the load (see Fig. 13), and it is only when the process of loading has been many times repeated that the magnetic change brought about by loading is just opposite to the magnetic change brought about by unloading
Whenever, indeed, we are observing the effects of an

NO. 1146, VOL. 44]

alteration of physical condition on the magnetism of iron, we have to distinguish between the primitive effect. which is often very great and is not reversible, and the ultimate effect, which is seen only after the molecular structure has become somewhat settled through many repetitions of the process Experiments on the effects of temperature, of strain, and so forth, have long ago shown this distinction to be exceedingly important: the mole-

cular theory makes it perfectly intelligible.

Further, the theory makes plain another curious result of experiment. When we have loaded and unloaded the from wire many times over, so that the effect is no longer complicated by the primitive action I have just described, we still find that the magnetic changes which occur while we still find that the magnetic changes which occar with the load is being put on are not simply undone, step by step, while the load is being taken off. Let the whole load be divided into several parts, and you will see that the magnetism has two different values, in going up and in coming down, for one and the same intermediate value of the load. The changes of magnetism lag behind the changes of load. in other words, there is hysteresis in the



FIG. 13 -Effects of loading a soft iron wire in a constant field

relation of the magnetism to the load (Fig. 14). This is because some of the molecular groups are every time being broken up during the loading, and re-established during the unloading, and that, as we saw already, involves hysteresis. Consequently, too, each loading and unloading requires the expenditure of a small quantity of energy, which goes to heat the metal.

Moreover, a remarkably interesting conclusion follows This hysteresis, and consequent dissipation of energy, will also happen though there be no magnetization of the cules are magnets. Accordingly, we should expect to find, and experiment confirms this (see Phil. Trans, 1885, p 614), that if the wire is loaded and unloaded, even when no magnetic field acts and there is no magnetism, its physical qualities which are changed by the load will change in a manner involving hysteresis. In particular, the length will be less for the same load during loading than during unloading, so that work may be wasted in every cycle of loads There can be no such thing as perfect elasticity in a magnetizable metal, unless, indeed, range of the strain is so very narrow that none of the molecules tumble through unstable states This may have something to do with the fact, well known to engineers, that numerous repetitions of a straining action, so slight as to be safe enough in itself, have a dangerous effect on the structure of tron or steel

Another thing on which the theory throws light is the phenomenon of time-lag in magnetization. When a piece of iron is put into a steady magnetic field, it does not ack instantly all the magnetism that it will take if time take instantly all the magnetism that it will take it time neitim, which is most noticeable when the field is weak and when the ron is thick. If you will watch the manner in which a group of little magnets breaks up when a magnetic force is applied to it, you will see that the process mention of the processing the process



Fig. 14 -Cycle of loading and unloading

to be It falls over, and then its neighbours, weakened by the loss of its support, follows usut, and gradually the disturbance propagates itself from molecule to molecule throughout the group. In a very thin piece of iron—a fine wire, for instance—there are so many surface molecules, in comparison with the whole number, and consequently so many points which may become origins of disturbance, that the breaking up of the molecular communities is too soon over to allow much of this kind of lagging to be noticed.

Effects of temperature, again, may be interpreted by help of the molecular theory. When ron or nickel or cobalt is heated in a weak magnetic field, its susceptibility to magnetic induction is observed to increase, until a stage is reached, at a rather high temperature, when the magnetic quality vanishes almost suddenly and almost completely.

Fig. 14, from one of Hopkinson's papers, shows what is observed as the temperature of a piece of steel is gradually raised The sudden loss of magnetic quality occurs when the metal has become red-hot, the magnetic quality is recovered when it cools again sufficiently to cease to glow Now, as regards the first effect - the increase of susceptibility with increase of temperature-1 think that is a consequence of two independent effects of heating structure is expanded, so that the molecular centres lie further apart But the freedom with which the molecules obey the direction of any applied magnetic force is in-creased not by that only, but perhaps even more by their being thrown into vibration. When the field is weak, heating consequently assists magnetization, sometimes very greatly, by hastening the passage from stage a to stage b of the magnetizing process. And it is at least a conjecture worth consideration whether the sudden loss of magnetic quality at a higher temperature is not due to the vibrations becoming so violent as to set the molecules spinning, when, of course, their polarity would be of no avail to produce magnetization We know, at all events. that when the change from the magnetic to the nonmagnetic state occurs, there is a profound molecular change, and heat is absorbed which is given out again when the reverse change takes place. In cooling from a red heat, the iron actually extends at the moment when this change takes place (as was shown by Gore), and so much heat is given out that (as Baijett observed) it re-



Fig. 15.—Relation of magnetic inductive capacity to temperature in hard steel (Hopkinson)

glows, becoming bighly red, though, just before the change, it had cooled so far as to be quite dull. [Experiment, exhibiting retraction and re-glow in cooling, shown by means of a long iron wire, heated to redness by the electric current.] In changes which occur in iron assets steel about the imperature of redness are very complex, steel about the imperature of redness are very complex, as the property of the red of the red of the red of the about the red of the red of the red of the red of the about the red of the red of the red of the red of the steel of the red of the red of the red of the red of the steel of the red of the red of the red of the red of the steel of the red of the steel of the red of the steel of the red of the steel of the red of the steel of the red of the steel of the red of the

uon belongs as much to cliemtury as to physics
An interesting illustration of the use of these models
has reached me, only to-day, from New York In a
paper just published in the Electrical World (reprinted
in the Electrican for May 29, 1891) Mr. Arthur Hoopes
supports the theory I have land before you by giving
curves which show the connection, experimentally found
by him, between the resultant polarity of a group of little
by him, between the resultant polarity of a group of little
when the field is applied, removed, reserved, and so on
Ishall draw these curves on the screen, and rough as
they are, in consequence of the limited number of
magnets, you see that they succeed remarkably well in
reproducing the features which we know the curves for
sold-irron to possess

It may, perhaps, be fairly claimed that the models whose behaviour we have been considering have a wider application in physics than merely to elucidate magnetic processes. The molecules of bodies may have polarity which is not magnetic at all—polarity, for instance, due to static electrification—under which they growth themselves in

stable forms, so that energy is dissipated whenever thate are broken up and restranged. When we straw a solid body beyond the restranged and the strawn a solid body beyond the restraining, as it were, internal friction. What is this internal friction due to but the breaking and making of molecular ties? And if internal friction, why not also the surface friction which causes work to be spent when one body rubs upon another? In a highly suggestive passage of one of his writings, 'Clerk Maxwell threw out the hint that many of the irreversible processes of physics are due to the breaking up and reconstruction, and, in studying them to engit, I think we may claim to have been going a step or two forward where that great leader pointed the way.

THE SUN'S MOTION IN SPACE

SCIENCE needed two thousand years to disentangle the earth's orbital movement from the revolutions of the other planets, and the incomparably more arduous problem of disninguishing the solar share in the confused multitude of stellar displacements first presented itself as possibly tractable little more than a century ago. In the lack for it as yet of a definite solution there is, then, no ground for surprise, but much for satisfaction in the large measure of success attending the strenuous attacks of which it has so often been made the object

Approximately correct knowledge as to the direction and velocity of the sun's translation is indispensible to a profitable study of steeral construction, but apart from some acquaintence with the nature of sidereal construction, it is difficult, if not impossible, of attainment One, in fact, presuppose the other. To separate a common fact, presuppose the other. To separate a common the sphere of three or four thousand stars is a task practicable only under certain conditions. To begin with, the proper motions investigated must be established with general exactivide. The errors inevitably affecting them must be such as pretty nearly, in the total upslay, to neutralize one another. For should they run mainly constituted to the control of the contro

Besides this obstacle to be overcome, there is another which it will soon be possible to evade. Hitherto, inquiries into the solar movement have been hampered by the necessity for preliminary assumptions of some lists, are highly insecure; and any fahre reared upon them must be considered to stand upon trescherous ground, and the second of the second

"Eacyc. Brit.," Art. "Constitution of Bodies" NO. I146, VOL. 44 tangential component, with the solar movement; and since complete knowledge of it, in a sufficient number cases, in rapid becoming accessible, while knowledge of cases, in rapid becoming accessible, while knowledge of cases, in rapid becoming accessible, while knowledge of report motions to the case of the proper motions by that of motions in line of sight is obvious and immediate. And the admirable work carried on at Pottdam during the last three years will soon afford the means of doing so in the first, if only a preliminary investigation of the solar translation based upon measure-

ments of photographed stellar spectra. The difficulties, then, caused either by inaccuracies in star-catalogues or by ignorance of star-distances, may be overcome; but there is a third, impossible at present to be surmounted, and not without magaving to be passed system through space start with an hypothesis most unlikely to be true. The method uniformly adopted in them—and no other is available—is to treat the indirect motions of the stars (their so-called motion peculiarum) as pursued indifferently in all directions. The steady science of probabilities in presumed to be tolar motion vausally transferred to them in proportions varying with their remoteness in space, and their situations on the sphere if this presumption be in any degree baseless, the result of the inquiry is gre lands falsified. Unleast the sphere is the mother on the whole, their discussion may easily be as frutiless as that of observations tainted with systematic errors. It is scarcely, however, doubtful that law, and not chance, governs the sidereal revolutions. The point open to question is whether the workings of grand sum-total of results which, from the geometrical side, may justifiably be regarded as casual.

The search for evidence of a general plan in the wanderings of the stars over the face of the sky has so far proved fruitless. Local concert can be traced, but no widely-diffused preference for one direction over any other makes itself definitely felt. Some regard, neverheless, ware be paid by them to the plane of the Milky Way, since it is altogether incredible that the actual conmethod of their revolutions.

The apparent anomaly vanishes upon the consideration of the profundates of space and time in which the fundamental design of the sidereal universe lies buried. Its composition out of an indefinite number of partial systems is more than probable; but the inconceivable lessurelines is more than probable; but the inconceivable lessurelines is more than probable; but the inconceivable lessurelines with which their mutual relations develop renders the harmony of those relations mappreciable by short-lived of a subordinate kind; they are indexes simply to the mechanism of particular aggregations, and have no definable connection with the mechanism of the hole. No considerable error may then be involved in treating them, for purposes of calculation, as indifferently directed; and the chief of our system relative to its more mimediate displacement of our system relative to its more mimediate displacement of our system relative to its more mimediate shoped for until sidereal astronomy has reached another saduum of progress.

Unless, mdeed, effect should be given to Clerk Maxwell's suggestion for derwing the absolute longitude of the solar apex from observations of the eclipses of the solar apex from observations of the eclipses of pupter's satellites (Proc. Roy. Soc., vol. xxx. p. 129). But this is far from likely. In the first place, the revent anything like the required accuracy. In the second place, there is no certainty that the postulated phanomena have any real existence. If, however, it be safe to assume that the solar system, cutting its way through space, virtually rauses an etheral counter-current, and if

it be further granted that light travels faster world than acquiests such a current, then indeed it becomes speculatively possible, through slight alternate accelerations and retardations of eclipses taking place respectively ahead of and in the wake of the sun, to determine his absolute path in space as projected upon the ecliptic. That is to say, the longitude of the apex could be deduced together with the resolved part of the solar velocity, the latitude of the apex, as well as the component of velocity perpendicular to the plane of the ecliptic, remanning, however,

The beaten track, meanwhile, has conducted two recent inquirers to results of some interest. The chief aim of each was the detection of systematic peculiarities in the motions of stellar assemblages after the subtraction from them of their common perspective element By varying the materials and method of analysis, Prof Lewis Boss, Director of the Albany Observatory, hopes that correspond-ing variations in the upshot may betray a significant character. Thus, if stars selected on different principles give notably and consistently different results, the cause of the difference may with some show of reason be supof the dimetricle may write some now to reason to sup-posed to reside in specialities of movement appertanting to the several groups. Prof. Boss broke ground in this direction by investigating 284, proper motions, few of which had been similarly employed before (Astr. Jour., No. 213). They were all taken from an equatorial sone 4° 20′ in breadth, with a mean declination of +3°, observed at Albany for the catalogue of the Astronomische Gesellschaft, and furnished data accordingly for a virtually independent research of a somewhat distinctive kind. was carried out to three separate conclusions. Setting aside five stars with secular movements ranging above 100, Prof. 100s divided the 279 left available into two sets—one of 135 stars brighter, the other of 144 stars fainter, than the eighth magnitude. The first collection gave for the goal of solar translation a point about 4° north of a Lyra, in R.A. 280°, Decl. + 43°, the second, north of a Lyrze, in R A. 280°, Decl. + 43°, the second, one some thirty-seven minutes of time to the west of 8 Cygni, in R A 286°, Decl + 45°. For a third and final solution, twenty-six stars moving 40"-100" were rejected, and the remaining 253 classed in a single series upshot of their discussion was to shift the apex of move-ment to R.A 289°, Decl. + 51° So far as the difference from the previous pair of results is capable of interpretafrom the previous pair or results is capacite or interpreta-tion, it would seem to imply a predominant set towards the north-east of the twenty-six swifter motions subse-quently dismissed as prejudical, but in truth the data employed were not accurate enough to warrant so definite employed were not accurate enough to warrant as definite an inference. The Albany proper motions, as Prof. Boss was careful to explain, depend for the most part upon the right ascensions of Bessel's and Lalande's zones, and are hence subject to large errors. Their study must be

regarded as suggestive rather than declaive.

A better quality and a larger quantity of material was disposed of by the latest and perhaps the most laborous investigator of this intricate problem. M. Oscar Stumpe, of Bonn (Matr. Nack, Nos. 2995, 3200) took has start, to the number of 1054, from various quarters, if testing, however, the movement attributed to each of not testing, however, the movement attributed to each of not less than 10° a century. This he fixed as the limit of secure determination, unless for stars observed with exceptional constancy and care. His discussion of them is instructive in more ways than one. Adopting the additional control of the secure of the secure of the security of the sec

M. Stumpe's intrepid industry was further shown in his disregard of customary "scamping" subterfuges. Expedients for abbreviation vainly spread their allurements;

every one of his 2108 equations was separately and resolutely solved. A more important innovation was his substitution of proper motion for magnitude as a criterion of remoteness. Dividing his stars on this principle into four groups, he obtained an apex for the sun's translation corresponding to each as follows—

Group	Number of	Proper motion	Apex				
1	included stars	0 16 to 0 32	RA.	287 4	Decl.	+ 42°	
11	340	0 32 to 0 64	,,	279'7	**	40'5	
III	. 105 .	0 64 to 1'28	,,	287 9	.,	32 1	
IV.	. 58	I 28 and unward	g	285.5		30.4	

Here, again, we find a marked and progressive descent of the apex towards the equator with the increasing swiftness of the objects serving for its determination, swiftness of the objects serving for its determination, the most genume position, because the one least affected by stellar individualities of movement. By nearly all recent investigations, moreover, the solar print de mire has been placed considerably further to the east and their predecessors; so that the constellation Lyra may now be said to have a stronger claim than Hercules to middle it; and the necessity has almost disappeared for include it; and the necessity has almost disappeared for needing galectic plane.

From both the Albany and the Bonn discussions, there

From both the Albany and the Bonn discussions, there emerged with singular clearness a highly significant reliation. The mean magnitudes of the two groups into which Prof. Boss divided his 279 stars, were respectively 65 and 85°. In lost environment of 1979 stars, were respectively 66 and 86°, the corresponding mean proper motions 21° of and 80°. In lother words, as see of stars on the whole larger sum-toral of apparent displacement. And that this larger sum-toral of apparent displacement. And that this approximate equality of mean distance was made manifest by the further circumstance that the secular journey of the sun proved to subtend nearly the same angle whichever of the groups was made the standpoint for its survey, lodeed, the fainter collection actually gave the larger magnetic stars of the groups was made the standpoint for its survey, lodeed, the fainter collection actually gave the larger magnetic stars of the superior support of the groups and made fair and applied the support of the groups and so fair and applied to the earth than the much brighter ones considered apart.

"Å result similar in character was reached by M Stumpe. Between the mobility of his star groups, and the values derived from them for the angular movement of the sun, the conforming proved so close as materially to strengthen the inference that apparent movement to strengthen the inference that apparent movement classified stars scened, on the contrary, quite independent of their mobility. Indeed, its changes tended in an opposite direction. The mean magnitude of the slowest group was 60, of the swiftest 65, of the intermediate pair 67 and 671. And these are not isolated apparent of the contrary of

What meaning can we attribute to them? Uncrutically considered, the yearn to assert two things, one reasonable, the other palpably absurd. The first—that the average angular velocity of the stars varies inversely to double; the account—that their average apparent lustre to double; the account—that their average apparent lustre than anothing to do with greater or less remoteness—few will be disposed to admit. But, in order to interpret ruly, well-ascentamed if unexpected relationships, we must remember that the sensibly moving stars used a multitude sensibly fixed; and that the proportion of stanonary to travelling stars rises rapidly with descent down the scale of magnitude. Hence a mean

struck in disregard of the zeros, is totally misleading; while the account is no sooner made enhanstive than its anomalous character becomes largely modified. Yet in does not wholly disappear. There is some warrant in a preponderance, among suns endowed with high systiad speed, of small, or slightly luminous, over powerfully radiative bodies. Why this should be so, it would be fulls, even by conjecture, to attempt to the PLEEKE.

A M. CLERKS

NOTES

THE respect in which science is held in Germany was strikingly displayed on Tuesday, when Prof Virchow celebrated his seventieth birthday The occasion was regarded as one of national importance, and much honour was done to the silves. tigator who, in the course of his great career, has given a fresh impetus to so many departments of research. In the morning, congratulations were offered to him in the large hall of the Kaiserhof Hotel, Berlin. The room was crowded with professors, academicians, and men of science from all parts of Europe, and on a long table were innumerable presents, medals, diplomas, and addresses. Short speeches were delivered on behalf of a series of deputations, the first of which was headed by Dr. Bartsch, one of the chief officials of the Ministry deputation, consisting of the professors of the Medical Faculty of the University of Berlin, and headed by Prof Hirsch, the Dean, was followed by another from the Berlin Academy of Science, for which Prof von Helmholtz spoke Forckenbeck, the Burgomaster of Berlin, heading a deputation from the Municipality of the capital, presented Prof Virchow with the freedom of the city, referring gratefully to all that he had done to improve the health of the community. An address and medal, sent by English scientific bodies, were presented by Dr Simon and Mr Horsley, and then came congratulatory addresses from the Medical Faculties of many foreign cities, including Amsterdam, Brussels, Stockholm, St l'etersburg, Moscow, Psvia, and Tokio | the Virchow gold medal, for which contributions had been sent from all sections of the medical world, was presented by Prof Waldeyer Frau Virchow received a silver replica, and bronze copies were given to the other members of the family and to the scientific bodies which had subscribed for the medal. In the afternoon, a second meeting was held in the large hall of the Pathological Institute, where, as the Berlin correspondent of the /tmes says, "an almost endless procession of learned bodies and other corporations, presenting gifts and addresses, defiled before Prof. Virchow" The day's proceedings lasted from 10 a m. to 4 p.m., but it was noted, we are glad to say, that Prof Virchow "seemed in no way fatigued by his exertions." More speeches were delivered in the evening, when a "Commers," or reunion. of his friends and admirers was held in Kroll's Theatre

This ordinary general meeting of the Institution of Mechanical Engineers will be held on Wedinesday sering, Cotober 26, and Thurnday evening, October 29, at 25 Great George Street, Westimmater. The chair will be taken at half past seven p.m. on each evening by the President, Mr. Joseph Tominnoo. The ballot lists for the election of new members, associates, and graduates having been preriously opened by the Council, the masse of those elected will be announced to the meeting. The nomination of officers for election at the next annual general meeting will the place. The following papers will be read and discussed, as far as time permats:—On some details in the construction of modern Lancashire boller, by Mr. Sanuel Boswell (Wedensday); First Report to the Alloys Research Coumittees, by Prof. W. C. Robert-Austen, C. B., F. R. S. (Thursday).

THE anniversary meeting of the Mineralogical Society will be held in the apartments of the Geological Society, Burlington House, on Tuesday, November 10, at 8 p m.

THE International Congress of Analytical Chemists and Microscopists met at Vienna on October 12 and 13. The subject discussed was the adulteration of food-stuffs.

GREAT preparations are being made for the meeting of the Australasua Association for the Advancement of Seence whole is to be held at Hobart, Tasmana, in January next. It is expected that the meeting will be most successful. The members of the Royal Society of Tasmana are congentuating economist, proposes to attend the meeting and to read a paper. His Excellency Sir R. G. C. Hamilton, who will preside, tried some time ago to secure the presence of Prof. Huxley also, Drof. Huxley replied that he had pleasant recollections of Tasmana as it was forty three years ago, and it would have uncreased the presence of the pre

ONE of the last surviving pupils of Dalton died at Bolton on October 6. Mr William B, Watson was born at Bolton in January 1812, and educated at the local grammar-school. He afterwards studied for some years under Dalton at Manchester, and became so devoted to his teacher that he was chosen to help in the nursing of Dr. Dalton during the illness following his first paralytic seizure Mr. Watson also assisted in many of Dalton's researches, and is mentioned by name in his papers in the Philosophical Transactions on the composition of the atmosphere as "an ingenious pupil of mine, Mr William Barnett Watson " Mr Watson had a wonderful store of anecdotes about his old master, and used to speak with pride of the great care he took in all his work. As an instance may be mentioned the pains he took to compensate for his colourblindness. Dalton used to say that the bloom on a maiden's cheek and the colour of a faded green table-cloth seemed to him one and the same, and that he could only distinguish between the fruit and leaves on an apple-tree by their difference in shape Dalton had a book containing different colours of floss silk. and below these he carefully noted the names given to them by non-colour blind people, adding what the colour appeared to him to be Careful methods such as these enabled him generally to give an accurate description of the colour of a precipitate. Mr Watson carried on, together with his elder brother, Mr II H. Watson, a very extensive practice as an analytical chemist, and was much consulted in legal and commercial cases

Tits death of Mr. Charles Smith Wilkinson, the Government Geologuts of New South Wales, will be fit as a great loss, especially in his own colony. He esthusiasm in the cause of geological science, he acteasure knowledge of the geological features of Eastern Australia, and his admirable personal eastern Australia, and his eastern Australia eastern and remedient of his Society of New South Wales. And presented that Society he years 1853 and 1854. His east presented the Society events, on the 26th of August, was unconnect to the Society on the evening of the same day.

La Nature amounces the death of Prof. Edonard Lucas, who presided over the Sections of Mathematics and Astronomy at the recent meeting, at Marseilles, of the French Association for the Advancement of Science A pile of plates fell one day after disner while he was at Marseilles, and he happened to be struck in the cheek by a fragment of the broken earthenware. The hunt became more and more troublesome, and after his return

to Paris he died of erysipelas. M. Lucas was forty-nine years of age. He was a brilliant lecturer, and the author of several valuable books, the most important of which is his "Réeréations Mathématiques."

APPLICATION has been made for 20,000 square feet of space for the electrical duplay from Great Britan at the "World's Fair" at Chicago. Electricity, the new weekly journal publanded at Chicago, remarks that this application should "state rest all doubts in regard to the extent of the exhibit to be made by British manufacturers of electrical apparatius"

MR. C. E KELWAY IS now showing at the Royal Naval Exhibition an invention which promises to be of great practical value. It consists of an apparatus for manne and general electrical signalling A number of electric incandescent lamps are placed in a suitable frame, from which insulated wires are led to a key-board, similar to those used in typewriters, or compound-switch A key is appropriated for each letter of the alphabet and for numerals. On this key being de pressed the electric current is switched on to the lamps representing the corresponding letter, which is at once shown to the observer. On the pressure being removed the lights disappear, and the next letter, or numeral, is in like manner shown, the words being spelt out at a rate more quickly than by the Morse system Mr Kelway claims that the applications to which this invention can be put are numerous. It might, he thinks, be of great service in naval tactics, and prove invaluable for military pur poses He also points out that it would enable mercantile vessels to communicate readily with each other and with the shore

A CORRESPONDENT asks whether there are any firms which supply magic lantern slides dealing with geological subjects

THE marine laboratory of biology and zoology, which is to be instituted at Bergen next year, will be open to any foreign in vestigators who may desire to study the marine fauna of that part of Scandinavia.

THE complete list of subscribers to the memorals to Bashog Berkeley, which has just been susued, contains the names of Profs Husley and Tyndall, in company with the Archbashog of Dublin and a number of biblogs and deans. Mr. Gladstone and Mr. Balfour meet together in the same list. The memoral is a beautiful resumbent figure by Mr Bruce Joy, R A, which has been placed in Cloyne Cathedral. The inscription to be placed on the mounteent has our by these announced.

THE Sociedad Cientifica "Antonio Alrate," of Mexico, who have lately moved atto new quarters, have just resolved to throw open their scientific library to the general public They are appealing on this ground to all foreign professors and scientific authors to send copies of their works to the library

THE Engineers' and Architects' Institute of Vienna have resolved to petition the Austrian Government that engineer attaches should in future be appointed to the embassies and legations in London, Berlin, Paris, St. Petersburg, Rome Washington, and to one Oriental city to be hereafter selected.

THE Royal Hortrealtural Society has issued a list of fruits which might be profitably cultivated by cottagers and small farmers in this country. The last (to which are added notes on planting, prusing, and manuring) ought to be widely distributed it contains all the information that is really necessary for the development of a most important industry.

ACCORDING to a telegram sent from San Francisco, a severe share of earthquake was felt there on October II, but no damage was done. At Napa, Californas, where a heavy shapk was seperienced, the chunneys were thrown to the ground, and several buildings were shattered. The State Instane Asylmin is reported to have been damaged, fistures being made in the walls. The Inmutes were seized with naine.

NO. 1146, VOL. 44

Wit take from La Nature of the 3rd inst, the following particulars respecting the destructive cyclone which visited Martinique on the 28th of August last The curve of a Richard barograph shows that the barometer commenced to fall about 2 pm , when it stood at 20 02 inches, while between 7 and 8 p.m u fell from 20 72 inches to 28 70 inches. wind at this time, too, reached its greatest violence, and continued with hurricane force for several hours, passing alternately from N.E. to South The recovery of the barometric pressure was equally rapid, the reading being about 20 70 inches before 10 p.m. M Sully, of Saint Pierre, writes that the lightning was constant, with varying intensity before and after the passage of the centre. The sound of the thunder was scarcely perceptible. owing to the howling of the wind and the noise caused by the falling roofs and houses. Globular lightning was seen on all sides during the hurricane, the country folks speak of globes of fire which traversed the air for several minutes, and burst about two feet above the ground. All the towns and villages were greatly damaged, the crops destroyed, and that usually verdant country presented the appearance of the depth of the most severe winter. The deaths are said to be 420 in number.

In the review of September in the U.S. Tilot Chart, it is pointed out that the month was unusually vorinny on the North Atlantic, as indicated by the storm tracks plotted on the thart. Two of these tracks, however, represent August storms, one of them being the track of the Martinique hurricane, and another the track of the hurricane that passed east of Hermuda on August 27. The Martinique hurricane, it appears, moved west-north-west along a somewhat irregular track, crossing over Puerto Rico, Turk's Island, Crooked Island, and lower Florids, finally dying out in the north-eastern Gulf. This univual course makes it of special interest, and its failure to recurve seems to have been due, possibly, to the opposition of the Bernuda hurricane, and amaner similar to the deflection towards Vera Cruot of the Cuban hurricane of September 1888. The Bernuda hurricane appears to have originated about 300 miles S. W. of the Cape Verde Islands on August 19

This correspondent of the Time, at Alexandra telegraphed on Ceoher 11 than three colorsal statuse, not feet high, of rose gannin, had just been found at Aboukir, a few fest below the unifice. The discovery was made from indications firmshed to the Government by a local investigator, Diannos Pasha. The first two represent in one group Rameses II and Queen Hestimars seated on the same throne. This is unique among Legytian satistic. The third status represents Rameses standing wingstin military attire, a sceptre in this hand and a crown upon his head. Both here hereophyphic inscriptions, and both have been thrown from their pedestals face downwards. Their site is on the monent Cape Tephynum, near: the remains of the Temple of Venus at Asinoe. Relies of the early Christians have been found in the same locality of the contraction.

We learn from the Breykon Hersids that a discovery full of merest to archaeologist has been made in Sausse. During some excavations near the depot of the Artillery Volunteers at South-ore, Lewes, the workmen uncovered as many at tensylvelght skeletons. They were all burned close to the vurface, and within an area of about 13 feet by 50 feet. As three were skeletons of women as well as of men, it is concluded that the save was not that of a battle-field, but 10' a place of burnal. A similar find was made in 1850 at Mailing Hill, which is not first was not that of which were accompanied by a large number of weapons and ornaments, the product of the product of

MR CLEMENT L. WALKER, while carrying on geological work in South-Western New Mexico, has also been pursuing archicological researches in that most interesting region during the last two years He proposes to publish a detailed account of his investigations, and in the meantime he briefly records some of them in the August number of the American Naturalist, On the east, west, and middle branches of the Gila River, in the Mogolion Mountains, there is an extremely rough, wild, and broken tract, and here, in the rugged eliffs, are found great numbers of ancient cliff-dwellings. Mr. Webster devoted considerable time to the study of these dwellings, making plans and sketches, and conving the drawings of many of the more interesting and extensive hieroglyphics painted on the rocks One of these ancient pueblos of the ehff-dwellers is situated in a lofty cliff which forms the side of a deep, narrow canon extending out from the west branch of the Gila. This eliffdwellers' village is in a fine state of preservation, and consists of upwards of twenty-eight rooms. Among the relics obtained in the rooms were specimens of several kinds of cloth, all made from the fibre of the Spanish dagger, matting of bear-grass willow work, sandals, cords of various sizes, feather-work, a ball and large skein of twine of the same material as the cloth, human and animal bones, stone utensils, great quantities of corn-cobs, corn, squash or pumpkin rinds, seeds and stems, corn-husks, beans, gourds, pottery, braided human hair of a brown colour, &c , and last, but by no means least, a perfectly preserved cliff dweller mummy. This was a mummy of a small child, with soft brown hair, similar to that found braided, only finer. It was closely wrapped in a considerable amount of two varieties of coarse cloth, woven from the fibre of the Spanish dagger, then wrapped in a large nicely-woven mat of bear grass, and tied on by cords of the same material as the cloth to a small curiously-shaped board of cotton-wood

576

SOME fine caves have lately been discovered near Southport. Tasmania At the meeting of the Royal Society of Tasmania in June, an account of them was given by Mr. Morton, who had visited them They are situated about four miles from Ida Bay, and a fairly good road leads to them The entrance is through a limestone formation. A strong stream flows along the floor of the chambers. The first chamber reached by Mr Morton and those who accompanied him showed some fine stalactites, and along the floor some tine stalagmites were seen. On the lights carried by the party being extinguished, the ceiling and sides of the caves seemed studded with diamonds, an effect due to millions of glow-worms hanging to the sides of the walls and from the ceilings Further on, several chambers were explored, each revealing grander sights The time at disposal being limited, the party had to return after traversing a distance of about threequarters of a mile, but from what was observed the caves evidently extended a distance of three or four miles. The only living creatures seen were the glow-worms. These caves, under proper supervision, should become, Mr. Morton thinks, one of the great attractions of the south of Tasmania.

In the Quarterly Statement of the Palestine Exploration Fund. it is announced that the first volume of the "Survey of Eastern Palestine," by Major Conder, has been issued to subscribers It is accompanied by a map of the portion of country surveyed, special plans, and upwards of 350 drawings of ruins, tombs, dolmens, stone circles, inscriptions, &c. It is also announced that the new map of Palestine, so long in hand, is now ready This map represents both sides of the Jordan, and extends from Baalbek in the north, to Kadesh Barnea in the south.

MR. E. R. MORSE contributes to the October number of the Engineering Magasine, a periodical issued at New York, an interesting paper on marble quarrying in the United States.

cemeteries and in buildings has become very extensive. Various foreign marbles, such as the African Red, Belgium Black, and Mexican Onyx, are employed in the interior decoration of buildings . but only Italian marble can be said to come really into competition with the American product, and the importation of this stone into the United States amounts only to about one-sixth of the value of the marble produced and sold at home. The quarrying of marble is practically limited at present to Tennessee, Georgia, Maryland, New York, Massachusetts, and Vermont Large and valuable deposits may exist elsewhere, but the expense of testing deposits is so great, and the chances that the product of new quarries may prove unsaleable are so numerous, that Mr Morse thinks that new marble fields are not likely to be developed soon

THE "basking shark" (Selache maxima, L) is apparently no very uncommon visitor in New Zealand waters. In the new volume of the Transactions and Proceedings of the New Zealand Institute, Mr T. F Cheeseman, Curator of the Auckland Museum, describes a specimen, over 34 feet long, which was stranded near the mouth of the Wade River. Mr. R. H. Shakspere, of Whangaparaoa, who saw the specimen very shortly after it was stranded, has informed Mr. Cheeseman that every spring several individuals of the same species can be seen near the entrance of the Wade River, and along the shores of Whangaparaoa Peninsula He believes that they visit these localities in search of their food, which he thinks is composed of small Meduse and other pelagic organisms. They can be easily recognized from their habit of swimming on the surface of the water, a portion of the back and the huge dorsal fin being usually exposed It is from this circumstance, taken with the fact that their motions are very often slow and sluggish, that they have received the name of the "basking shark" They are easily approached and harpooned, and on the west coast of Ireland as many as five hundred have been taken in a single season The liver often weighs as much as two tons, yielding six to eight barrels of oil. A few years ago, when sharks' oil was of greater value than it is at present, the oil from a single full-sized specimen would often realize from £40 to £50.

AT the meeting of the Linnean Society of New South Wales, on June 29, Mr. Froggatt exhibited some living beetles (fam. Curcultonida), which afford a good example of protective coloration They were found at Wellington, N S.W., on the trunks of Kurrajong trees (Sterculia), the bark of which they resemble so closely in tint and general appearance that it was quite by accident Mr Froggatt first recognized their true

MESSRS GAUTHIER-VILLARS have sent us the "Annuaire" for 1891 of the Municipal Observatory of Montsouris. It contains, as usual, a great mass of carefully selected and well arranged information We may especially note a collection of old meteorological observations made at Paris, and the following papers Parisian climatology, by M Léon Deseroix; chemical analysis of the air and of waters, by M Albert Lévy; thirteenth memoir on organic dust in the air and in waters, by Dr. Miquel.

MESSES G. L ENGLISH AND CO, New York, have found it necessary to use a supplement to the catalogue of minerals which they published in June 1890 So great has been the demand for minerals that they had three collectors at work during the summer-one in Europe, another in the southwestern part of the United States and in Mexico, and a third in Colorado.

THE new number of the Journal of Anatomy and Physiology opens with some valuable notes by Dr. R. Havelock Charles, Within recent years the use of American marble both in on the craniometry of some of the outcaste tribes of the THE Department of Public Instruction in New South Wales as issued a accord edition of "Wattles and Wattle-Barks," by J. H Maiden. It appears as No 6 of the Technical Education Series. The pamphle is intended to supply Australana farmers, actually a supply and the supply Australana farmers, regard to the value of wattles. According to the author, the demand for good waitle-bark becomes greater every years, and the supply does not cope with it "The word" wattle," we move the supply does not cope with it "The word" wattle," we may note, has become in Australia particulally synonymous with

AN interesting experiment has been lately made by M Chabry, of the Societé de Biologie, with regard to the pressure which an experiment of the pressure which as the produced by electrolyting perform on gas in a closed space. Which the highest principal performance and in this way of the state of the third performance of the state of the performance of the state of the performance of the per

THE first series of lectures given by the Sunday Lecture Society begins on Sunday afternoon, October 18, in St. George's Hall, Langham Pikee, at 4 p m,, when Sir James Crichton Browne, F R S, will lecture on "Brain Rust." Lectures will subsequently be given by Mr. Frank Kerniake, Mr. Wilter L. Bicknell, Mr. W. E. Church, Prof. H. Marshall Ward, F R S, Mr. A W. Clayden, and Sir Robott Ball, F R S.

An important paper upon persulphates is contributed by Dr. Marshall, of Edinburgh, to the October number of the Journal of the Chemical Society. The aphydride of persulphunc acid. SaO2, was obtained by Berthelot in the year 1878, by subjecting a well-cooled mixture of sulphur dioxide and oxygen to the silent electrical discharge. He afterwards found that a substance possessing oxidizing properties, and which appeared to be persulphuric acid, was formed in solution during the electrolysis of fairly strong solutions of sulphurie and; it appeared, in fact, to be identical with the substance obtained by dissolving his crystals of S2O, in water. The anhydride does not dissolve in water without partial decomposition, a considerable proportion decomposing into sulphuric seid and oxygen, and hitherto no salts of persulphuric acid have been obtained in the solid state. Dr. Marshall has now succeeded in obtaining the potassium, ammonium, and barrum salts in fine large crystals. During the course of an experiment in which an acid solution of potassium and cobalt sulphates was being electrolysed in a divided cell, it was found that a quantity of small colourless crystals separated. A solution of these crystals in water gave only a faint precipitate with barium chloride, but on warming barium sulphate slowly separated and chlorine was evolved. The solution also liberated iodine from potassium lodide. The crystals were, in fact, potasslum persulphate, KSO4. It was next sought to prepare them

from hydrogen potassium sulphate. A saturated solution of this salt was submitted to electrolysis in a similar apparatus, and at the end of two days a white crystalline deposit of potassium persulphate commenced to form. The crystals were from time to time removed until a considerable quantity of them had been accumulated. These, when recrystallized from hot water, yielded large tabular crystals, and sometimes long prisms when formed at the surface of the liquid. Analyses of pure samples yielded numbers agreeing perfectly with the formula KSO. From determinations of the conductivity of dilute solutions it would appear that the correct molecular formula is KSO, and not K.S.O.s On ignition of the salt, oxygen and sulphuric anhydride are evolved and potassium sulphate is left. The crystals are not very soluble in water, 100 parts of water at 0° dissolving 1 77 part of K5O. The aqueous solution gradually decomposes, hydrogen potassium sulphate being formed and oxygen liberated The pure freshly prepared solution is neutral to test paper The solution yields no precipitate with any other selt by double decomposition, the persulphates of most other metals appearing to be more soluble than notassium persulphate. A solution of lead hydrate in potash yields a precipitate of lead peroxide on boiling With silver nitrate no immediate precipitate is formed, but the liquid gradually acquires an inky appearance and after some time a black precipitate of silver peroxide, AgO, is deposited It would appear that silver persulphate is dissolved by water Fehling's solution gives a red precipitate of copper peroxide Ferrous sulphate is rapidly oxidized to ferric with considerable rise of temperature. Organic colouring matters, such as litmus, are bleached. Alcohol is oxidized to aldehyde in presence of water, but absolute alcohol has no action on solid potassium persulphate The pure crystals have a cooling saliae taste, which leaves a peculiar after-taste. The impure salt cyclyes ozone slowly Freshly prepared crystals have no odour, but after a time they emit a peculiar pungent odour quite different from that of ozone, and which appears to be due to persulphune anhydride When warmed with concentrated nitric or sulphuric acids the oxygen is liberated largely in the form of ozone. With hydrochloric acid chlorine is evolved. The ammonium salt NH4SO4 has been prepared in a similar manner, it crystallizes in long prisms and much resembles the potassium sait The barium sait crystallizes in beautiful large interlocking prisms containing four molecules of water of crystalli-

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (Macacus cynomolgus 5) from India, presented by Mr J Barratt Lennard; a Rhesus. Monkey (Macacus rhesus 9) from India, presented by Miss Corrie Chisholm : two Common Marmosets (Hapale jacchus) from South east Brazil, presented by Mrs Frederick Betts, two Bernicle Geese (Bernicla leucopsis), two Brent Geese (Bernsela brenta), European, pretented by Mr Cecil Smith, a Gamet (Sula bassana), British, presented by Dr. Davis eleven Gold Pheasants (Thaumalea pula 81), two Amherst Pheasants (Thaumales amherstie & &), two Silver Pheasants (Euplocamus nycthemerus & 9) from China, a Common Pheasant (Phasianus colchius &), British, four Ruddy Sheldrakes (Tadorna casarca), European, presented by Mr. Edwin J. Poyser; a Common Chameleon (Chamaleon vulgaris) from North Africa, presented by Mr. F. Manners; a Macaque Monkey (Macacus cynomolous) from India, deposited.

OUR ASTRONOMICAL COLUMN.

MEASUREMENTS OF LUNAR RADIANT HEAT.—Numerous measurements of linear radiant heat have been made at Bur Castle Observatory by Lord Roses and Dr. Copeland, and the results obtained have been published from time to time. During the total lunar eclipse of Cutober 4, 1884, Dr. Otto Bondaicker,

Lord Ro se's present assistant, carried out a senes of observations for the purpose of testing the artiking result previously arrived at by Dr. Copeland, viz., that "the maximum of heat exceed to occur some that before fail moon." If we then nearly proportionally to the light, becoming inappreciable on reaching the limits of totality. The minimum of heat apparently fell later than that of illumination. But the most remarkable fill later than that of illumination. But the most remarkable contact with the penumbra, and the commencement of total phase, all appreciable radiation vanished, between the end of total phase and the last contact with the penumbra, and even forty municia later, the heat had not returned to the vanished facts are remarked upon by Lord Rose in an introduction to a paper by Dr. Boeddicker, guing the results obtained during the maximum contact with the penumbra, and a decrease of heat seems even then to have set in. But excluding this distinct of the contact with the penumbra, and a decrease of heat seems even then to have set in. But excluding this disministration of heat exhibited by the curve connecting the discretization of the set and the contact with the penumbra, and a decrease of heat seems even then to have set in. But excluding this disministration of heat exhibited by the curve connecting the discretization of the set and the set of t

Two New Variable Stars—The Rev T E Espin has found two new variable stars in Cygnus, viz D N + 36 3852 and 1 M + 49 3339. They are both of a strong red colour The first has a Type III. (Group II) spectrum, and the second belongs to Type IV (Group VI)

A NEW ASTRACIO,—The asteroid observed by Dr Palus on August 22 turns out to be Mediusa (12), as was suggested by Dr Berberich. On this account, the asteroids from (11) to (12) must be numbered from (11) to (11), and the one discovered on September 24 by Charlois will be (11)

A NFW COMET —A high comet was discovered on October 2, by Mr. E E Barnard, at Lick Observatory, in R.A 7h 31m 24s, and Deel -27° 54′ It was moving to the south east

THE IRON AND STEEL INSTITUTI

THE autumn meeting of the Iron and Steel Institute was held on Toesday the 6th inst and Weinberday He 7th insti, under the presidency of Sur Frederick Abel. After the excellent of last year's meeting in the Unsted States, the gathering meeting in the Unsted States, the pathering the continuous of this Sciercy to had done not need to see the the custom of this Sciercy to had done, and the second, in the autumn, either in the provinces or abroad. This year at was proposed that Birung's being int London, and the second, in the autumn, either in the provinces or abroad. This year at was the great town of the Mildands does not appear to have re-forthcoming, the Council was thrown back on the meeting, but the great town of the Mildands does not appear to have re-forthcoming, the Council was thrown back on the meeting-bit in one point, at any rate, the meeting was a success, as on Tuest-day a larger number of member travelled down to Woolwich, where a waith had been arranged to the Royal Areasal, than the council was the scale of the Council was thrown as the Council was thrown the scale of the Council was thrown as the council was the scale of Council was thrown as the scale of Council was thrown as we consider the scale of Council was thrown as we considered the scale of Council was thrown as we considered the scale of Council was thrown as a scale of the Council was thrown as the scale of Council was thrown as the scale of Council was thrown as a scale of the Council was thrown as the scale of Council was thrown as the scale of Council was thrown as the council was the scale of Council was thrown as the scale of Council was thrown as the council was the scale of Council was thrown as the scale of Council was thrown as the council was the scale of Council was thrown as the council was the scale of Council was thrown as the council was thrown as the council was the council wa

where a visit had been arranged to the Koyal Arsenas, tans perhaps have even being pot together before on an eccurson, The executions are generally the leading feature of the meeting just past—namely, that to Woolwuch Arsenal. The following is a list of the papers read—On the constitution of ordance factors, by Dr William Anderson, F. K.S. Director-General of Ordanner Fastorses; on the measuring untrusential Woolwich, by Captain Holden, R.A., Proof Officer at Woolwich, tog the manifacture of continuous sheets of malleable aroa and steel direct from fluid metal, by Sr Henry Bessmer, F.R.S., on illustrations of progress in material for shiphulding and engineering in the Royal Navil Exhibition, by W. II White, C.B., Chief Consurator, on the forging press, by W. White, C.B., Chief Consurator, on the forging press, by W. Lausen of and a field, by F. J. R. Carulla, Debris, on the climits of the control of shiphur from page-no by J. Massacer, of Hearth, of the Control of Section of Sectio

Sortool, by B 11 Inwaite, Laverpool.

Woolwich, D 74 Anderson's contribution was taken first. It is a currous fact that the Director-General of Ordnance Factores, whose admires nead to claim, before he occupied his present whose admires nead to claim, before he occupied his present man, should have contributed what is perhaps the least scentific paper to be found within the Transactions of the Institute. The paper was what its tule indicated, strictly a description of the paper to be found within the Transactions of the Institute. The paper was what its tule indicated, strictly a description of the comprise the Laboratory, Gun Factory, and Carrage Department at Woolwich, the Gunpowder Factory at Waltham Abbey, and the Small Arms Factores at Panied Lock and Birmighton worked on commercial principles. Dr Audieron is an accurate work in the field of mechanical engineering which he has done, factoring establishment were worked with a view to profit after the manner of Woolwich Arienal, the profits probably would be very small. The paper tells us that \$4,00,000 is invested in 17,000, of which 17,000 are at Woolwich in the finding the following paper in the interest of \$1,130,043, and metansis for \$1,130,043, and metansi

Capian Holden's paper was on an interesting subject, but was far too bref to treat it an aptiving approaching an adequate was far too bref to treat it in aptiving approaching an adequate on the control of the control

all sources of error in the instrument, and the precasions taken are briefly outlined in the page, and the precasions taken. After the reading of these two papers the members were conducted round the Arsenal, but such official wrath was threatened against any person who wrote for printing about anything he part of the proceedings.

saw that we are too ingineers on make uning exercises to map of the proceedings, the metting the members assembled at the institution of Civil Engineers, für Frederick Abet, the Presentent, sayan occupying the chile. The first paper taken was a contribution by Sur Henry Bessenser, in which he described an invertion of his, devised easily Jall'a contury ago. This consistency is the contribution of the co

plicated and costly methods should have stood so long, consider-ing that Sir Henry Bessemer's patents have long since expired, ing that Sir Henry Desember's patents have long since expired, and his direct proces is no pen to anyone to adopt. The metal, and the direct proces is not pen to anyone to adopt. The metal, to be afterwards rolled into alabs or billets, its just poured on to the top of a pair of water-cooled rolls placed with their axis, in the same horizontal pinne. The rolls are caused to revolve, and the molite metal finds it, way down between the space left. and the molten metal finds its way down between the space left between them, and is thus rolled out into a continuous plate or between them, and is thus rolled out into a continuous plate or sufficient to solidly the metal. That the process is provide Sir Henry proved over droty years ago, that it may be made commercially successful appeared to be the unanimous opinion of the many competent critics who spoke in the discussion of the many competent critics who spoke in the discussion Under these circumstances it would seem that the only reason why there should not be a radical change in the way of why there should not be a radical change in the way of manufacturing steel plates is that the process is open to every one, and, as there are no patent rights to be acquired, it may be worth no one's while to go to the initial expenses of starting a new process just to show competitors how to do the same

Mr. W II White's paper on the shipbuilding material at the Naval Exhibition was a useful and interesting contribution, although not so exhaustive as might have been desired. It would, however, he too much to expect so important a public would, however, let too much to expect so important a public servant as the Director of Naval (onstruction to devote his time to writing testisties for technical Societies. What Mr of shipbuilding has been simplified and cheepened by the steel manufacturer, who now rolls many special sections, such as 2 bars, thannot bas, If Lawr, T bulbs, and angle bills, thuy saving a vast amount of building up and riveting in the actual saving a vact smount of buttoning up and reveiling in the actual construction of the ship. The increase in the size of plates, both for ship and boiler work, was also pointed out by the author. Two specimens of buter plate are shown in the Exhibition, which are both 11 in thick and respectively 42 ft. Examination, which are not it is in the non-tespectively 42 it tools by 65 ft wide. An other way in which the steelmaker and founder has helped the shiplistiller is in producing complete parts of ships, such as stern frames and stems, especially the spir sems of war vessels, which necessarily have to be of measure construction. In old days, when such parts were under of wrough iron, the forging had to he machined to form the recesses or "rabbets" necessary far and in the case of such heavy articles was most difficult to excessively contained to the machined to form the recesses or "rabbets" necessary far and in the case of such heavy articles was most difficult to excessively contained to the case of such heavy articles was most difficult to and in the case of such neary articles was most cimeus, co-accomplish at all. With steel casting a little or no machining is required. Mr White exhibited a large hull diagram of a ram bow for a recent battle-ship. The part issimade hollow, or rather recessed, and shelves are cast on to receive the plating of the decks: and the sitachment of hreats thook, & The shanglor raiher recessed, and shelves are cast on to receive the plating of the decks, and the attachment of breast hooks, &c The author also referred to the exhibits of armour plate made at the Exhibition, but the subject is to lengthy for us to go into here, excepting to say that nickel steel has been proved by test to show such good results for amour that some of the "econdary armour plating for five first class battle-ships is now being made of that material.

of that material.

Mr. W D Allen, in his paper, described a forging press, which, although it has been at work for some years at the Bessemer Works in Sheffield, is so ingenious, and so new to which, although it has been at work for some years at the lessement Works in Schleids, so in egenous, and so new to be element to the some some some some some some some has the appearance of a steam liammer, and, indeed, there is a steam cylinder at the top, just as an a hammer. The use of the steam, however, is only to raise the tup when the hydraulic programs are released. The press consist of an anvil block below pressure as released. The press consist of an anvil block below ram works in a hydraulic cylinder, and is scarred through the top end of the latter in the shape of a stout staff or shank, which may be described as a tail rod to the ram. Attached to this is the pittor not off the steam prior, the latter of comes working in its own cylinder. The steam cylinder and hydraulic cylinder, the hydraulic cylinder, the pulped with water at pressure by a sattable pump, the barrel of the pump being in direct communa cadm with the bydraulic cylinder, there being no valve of any kind between the two. If we have made our explanation clear, stroke with the pump plunger (the same water flowing back-wards and forwards continuously), at being remembered that the There are actually two plungers, the pump being of the displex type.

* There are actually two plungers, the pump being of the duplex type but this is a detail which does not affect the principle

NO. 1146, VOL. 44]

steam cylinder has always a tendency to lift the ram. Thus, upon the pump making a forward stoke, the water in its barrel is forced into the hydraulic cylinder; the ram is thus forced is forced into the nyiriatuic cylinder; the ram is this forced down, and gives the necessary queeze to the work on the anvil. The pump plunger then starts on its return stroke, and so, by enlarging the space in the pump harrel, enables the hydraulic man to rise and press the water out of the cylinder and back into the pump. The rising of the ram is caused by the lifting auton of the team micro and the pump and the pushon. The latter, it will be remembered, heing sitached to the ram. Of course the water remembered, neing attached to the state of this pressure on the downward stroke. The chief use of this press is to produce downward stroke The chief use of this press is to produce work of any given thich-nescs within the range of the machine. This rend is attained by regulating the volume of water used The action may be explained as follows: We will suppose, merely for simplicity sake, the content of the pump barrel to be one cubic foot, and that of the hydraulic cylinder, when the ram is at the full extent of its stroke, to be two cubic feet. We will neglect the connecting sipe between the two, as that is not a variable and does not affect the principle. If there be admitted to the pump but one cubic foot of water as the plunger into the hydraulic cylinder, and the ram would therefore only descend one half its stroke If the stroke were two feet the travel would be 12 inches, whilst there would be 12 inches travel would be 12 inches, whilst there would be 12 inches, of space between the anvil and the lower side of the squeezing tool on the end of the ram. Objects of 12 inches, or above 12 inches in thickness, could therefore be forged. If, however, an article 6 inches thick had to he worked, another half cubic foot of water would have to be admitted the pump barrel would only accommodate one cubic foot of water, the extra half cubic foot would remain permanently in the hydraulic cylinder, and the ram would therefore not go, by six inches, to the top of its stroke, in other words, the traverse of the ram would be carried six inches nearer the anvil. It will be remembered that the upward movement of the ram is effected by the seems cylinder, which is powerful enough to lift the dead workpit of the inn, but is overcome by the hydraulic pressure It will be seen that by regulating the wolams of water in the lift of lift by the steam cylinder, which is powerful enough to lift the dead warn me chance or getting a little too much work on at the last minutle, cannot equal the alsolutely ourrect results of this automatic system. There is a very ingenious valve for regulating the admission of water to fine gradations, so as to get work accantacly to gauge, but we have, perhaps, given enough description of mechanism for one article.

Mr. Carulla's paper was interesting and suggestive. He was reasoned in multium baseomers.

engaged in melting Bessemer scrap in pots when a crucible gave way in the furnace just as fusion was nearly complete, the greater part of the contents flowing out into the fire. The greater part of the coolents flowing out into the fire The meller was up withinging the crucible out, and, instead of finding an empty broken crucible in the tongs, he discovered a number of shell corresponding us hape with the please originally charged, obtained to the property of the control of the please originally charged, phenomenon, upon which he invited an explanation. That discovered in the please of the control of the please of the control of the control of the peakers, but of the way in which the business of these meetings in carried on The remain applies not only to the foundation of the control of the total control of the control of the control of control of the control of the control of the control of control of the Iron and Steel Institute, but to most of the technical Societies of the same class. When a meeting in held, a mad of papers are grought forward and read more or less hurrheidy, and the paper of the moment. It is seedless to point out that no austastory discussion of matters involving scientific principles can be carried on in this way. Mr. Carulla's paper is, as we have aid, suggestive, and a complete explanation of the facts be tattes would doubless lead to most important discoveries in

The prevs ram makes a stroke of si inches, and its diameter is 30 inches. The total pressure at 3 tons per square inch would be 1700 tons.

metallurgical science. In such cases as this we think it would metalizingual science. In such cases as this we think it would be wise to read the paper and then postpone discussion small the next meeting, or, by preference, to have the paper printed in appearance call for discussion. If would appear evident that the interior of the precess of scrap had a lower meltung point than the externer part which formed the shells obtained, and the explanation of the variation is melting-point was the point requiring consideration. Liquitors of the elements is raturally explanation of the variation in melting-point was the point requiring consideration. Liquid con of the elements is raturally required to the control of the control is raturally included to the control of the control of the control of the liquition as itself an obscure matter. Mr. Sheisu would explan tender the increase pasts more easily feasible. It is had, in raking tender the increase pasts more easily feasible. It is had, in raking the control of the control of the control of the control of the same metal, the case this formed being filled with graphitic carbon. Mr Galbrath attributed the phienomenon to the surface of the metal poses having absorbed an inclusible outderwess at a high temperature There was, however, more in the circumstanges

temperature There was, however, more in the circumstances described than the meeting was prepared to explain of hand, and it would be well if the discussion could be reopened at the pring meeting on brought in again by another pages, proposed the most valuable of the meeting. It is a pleasing thing to see a foreign steelmaker patting his experience so unereverdly at the disposal of his English fellow-workers, and the thanks of the lastitute are doubly due to the author for his valuable and practical paper. There is also an economic lesson in this metter, for the apparatus described owed his surfacetion to the matter, for the apparatus described owed its introduction to the German collier; great strike of two years ago. Since then these has not only been a dimension in the amount of coal wrought, but the quality has also fallen only. So that the proportion of deat-planitation process, the method of which forms the subject of the paper. Manganiferous molten pig. poor in sulphur, is added to sulphuretted pig roon, poor in manganese; the result being that the method is described by the properties of the paper. Manganiferous molten pig. poor in sulphur, is added to sulphuretted pig roon, poor in manganese; the result being that the main is described pinch pinch forms and allow a sulphure and the pinch p of about twice the size would be advisable. Details of the working are given by the author, and will be of great use to steelankers working with phosphore pig. In the discussion the inventor, so I've the leaf the limitating that a waring of 22.47, per ton could be made by this method over the process of re-miding pig in the cupols; is step which has to be ladeen of re-miding pig in the cupols; is step which has to be ladeen farmace. In the large mixer, metal from two or more firmaces on the brought tengenter, we was contribution by Mr. B. The cupy remaining replaces as a contribution by Mr. B. The cupy is the state of the state of the metallungued department of the Sheffeld Technol School, which was read in burf abstract by one of the clerical staff, after which the meeting was tomposity to a condition by the usual vote of thanks.

CARL WILHELM VON NAGELI.

THE death of Carl Whileim von Nageh, on May 10, 1891, removes the last surrivor of that distinguished group of betanitz who, side by side with toologists such as Schwann and history of the career of Nigeh; as of popular there more than the career of Nigeh; as of popular there is no standard to the career of Nigeh; as of popular the held a sleding position in the advance of the scene; rad, while has leading position in the advance of the scene; and, while has most recent work it is touch with those letter developments of bology which are connected with the name of Weismann. His work reached every side of the science. Systemate bology, the contract of the science of the scie THE death of Carl Wilhelm von Nageli, on May 10, 1891,

was devoted to coors, but he soon showed a taste for naturas history, which appears to have been in some degree inspired by his sister. His education as a boy was begun at a private school, of which his father was one of the founders, and was completed at the Zurich Gymnasium, where he did well. He

then matriculated at the recently-established University of then matriculated at the recently-established University of Zurich, with the view of studying medicine. As a student, he is said to have been strongly influenced by the "Naturphilosophie," as taught by Oken. He soon lost his taste for medical studies, and, owing to his mother's influence, was

medical studies, and, owing to his mother's influence, was allowed to migrate to Genera, where he devoted himself to the study of hotany under De Candolle. Nageli took his doctor's degree at Zuinch in 1840: his dis-sertation on the Swiss species of Circitism was decidiated to Oswald Heer, and was his first contribution to that minute investigation of species which formed so characteristic a part of his life work.

his life's work. Subsequently Nageli spent a short time at Berlin, studying, among other things, the philosophy of Higgel. A metaphysical spent of the property of the studying among other things, the philosophy of Higgel. A metaphysical few studying the studying th influence of Schleiden however, is manifest throughout, someintuence of Schleiden however, is manifest throughout, some-tmest in an injurious degree, though the independence of Nageli times and the state of the state of the state of the state of the policy of the state and on his wedding tour he spent a long time on the south-coast of England, and there collected much material for his important work on "Die neuern Algen-systeme," published in

coast of England, and there collected much maternal for his imponents work on "Die neueren Algen systems," published in Stock and the state of the continent he became a Privateleust at Carona had lecture at the veternary school, and ason afterwards he was appointed Professor Estraordinstrus. In 1850 his association of the state of the state

microscopic work.

such as few awants can have enjoyed. Without attempting to give an adequate account of Nigeli's scientific work, a task which would far exceed both the limits of this article and the powers of the witter, some idea may be given of the salient points in his career as an investigator. Nageli's far histological paper, so far as we are aware, is on the development of pollen (1841). This already marks a de-

The details of Nigeli's life are taken from the funeral address delivered by the colleague, Prof. Cramer, and published in the News Zarcher Zeitung for May 16, 1801.

ided advance on Schleiden's theory of free-cell formation, for odded advance on Schleiden's theory of free-cell formation, for Nageli maintains that the spoon innother-cells are not formal dreetly around a cytoblast (nucleus) but around the whole granular contents, in the modile of which a fee cytoblast lies from the influence of Schleiden's histological liteories. It is interesting that in this paper he desembed and 1 clearly figured the two nucles in the pollen-grain of an CEnothers, though he did not know that this was a contact phenomenon. The jimportance of this observation was not appreciated until Elfving, Strasburger, and Guignard, investigated the subject in our

Nageli's "Botanische Beitrage" contributed to the volume of Lisance for 1842, include some important papers. In those on the development of stomata and on cell-formation in the root-apex, he endeavoured to reconcile his own accurate observations apex, he endeavoured to reconcile his own accurate observations with Schiedenian theories, and was thus led to oppose Unger, who had already recognized that vegetative cell-formation is a process of division. A paper on Fungs in the interior of cells is interesting, because the existence of such endophytic forms was at that time regarded as establishing a presumption in about of a school and the processing the superior of the processing that the control of the processing the proces

apontaneous generation
The Zestschrift fur Wissenschaftliche Botanik, 1844-46, is a very remarkable publication. It never got beyond its first volume, but it may be doubted whether any book of its size has been more important for the progress of the science. Nageli's introductory paper, "Ueber die gegenwartige Aufgabe der Naturgeschichte, insbesondere der Botanik," is very metaphysical in tone, and is not free from a certain youthfal pedantry Great stress is laid on the absolute difference of species—a con-ception which, as Nageli tells us in one of his later works, did ception which, as Nagelt tells us in one of his later works, did not prevent his believing eren then in the origin of species by descent. The study of development is treated as a philosophic of the second of the

crystalization Some of the most doubtful of his own later generalization, however, were affected by the same source of error-manely, too great eagerness to find a simple physical explanation for biological phenomena. Nageli, in this paper, devotes much space to the distinctions between annuals and plants. He decirvely repers the idea of between the same and plants are the decirvely repers the idea of world for the property of the same property of

would contrainct in a "Disoutnest der Begrine"—an argument which now seems strangely out of place in natural science the whole paper is of great interest as showing the print of view from which biological questions were regarded at that time by a brilhant and philosophical naturalist just entering on his life; work

life's work

The two ages in the Zoitcher's, on the nuclei, ormation

The work presented cold, (5k, and 8 days), or the property

greatest importance to histology, finally eatablishing the constant

cocurrence of cell division as the one mode of vegetatere cell
formation. This coccision was only reached in it complete

formation. The coccision was only reached in its complete

formation. The coccision was only reached in the complete

formation of the details of the process were in some respects

the more correct, still Nagel established the main facts of the

division of the nucleus and of the cell on a broad basis of division of the nucleus and of the cell on a broad basis of observation. These papers, as well as one on the intricular structures in the contents of cells (nucles, nucleoil, chlorophyll granules, &c) were translated by Henfrey for the Ray Society, to the great benefit of English students, as the writer

Society, to the great onemat or anguins students, as the written of this article can testify.

In the same journal there are several algological papers, the most important of which is the complete and admirable account of Casterga proisitors, the extraordinary histological stricture of which as the relationship to the other Siphones Nagel already thoroughly understood. It is interesting that in this paper he describes both the cell-wales need as growing by apposition, a view to which we have now returned, owing to the

observations of Strasburger and Noll, in opposition to Nageli', own later theory of intussusception propounded in 1858

The paper on Delesseria hypoglossium contains an elaborate account of the cell-divisions by which the thallas is built up Nageli here characteristically attributes great importance to the introduction of ideas of absolute mathematical form into

introduction of ideas of absolute mathematical form into physiology and systematic botany. The discovery of spermatozoids in the Ferni is one of the most important recorded in this volume. The essential points in the structure and development of the antheridia are described. in the structure and development of the antheridia are described rightly, and the movements of the spermatozards very accurately traced. Nageli calls attention to the nuclear reactions of the substance of the spermatozoids. He demonstrates the homology of these bydies with those of the masses and Chara and of Nazeli was at that time necessarily completely in the dark as to the relation of the spermatozoids to spore formation.

dark as to the relation of the spermatozonis to spore formation, for the archegionia and the process of fertilation were first dis-covered by 8 immski four years later Among other papers of final immstal importance may be mentioned that on the growth of missee, in which the apical cell-divisions and the development of the protonems are clearly a work which laid the foundation of our knowledge of the distribution of vascular bundles, and that on the reproduction of the Rhizzerps. This last is especially interesting. It is the Rhizocarps. This last is especially interesting. It is directed though very cautiously, a rainst the Schleidenian theory of fertilization as applied to these plants It is singular hov this theory, according to which the end of the pollen tube, after penetrating the embryo sac, itself became the embryo, took possession of the minds of botanists at that time, and led some possession of the mains of locianist at that time, and test some times to the strangest confusions, sometimes to a chance recognition of homologies, which could only belegitim telly proved at a later period of research. In the case of the Rhinocarps, the shell tenan theory assumed that these plants were really Phanerogams. Hence we find that he and Nazel agree in Prancogams there we not that he and Nagel agree to aching their microspores pilengrann, their microsporangit anthers, their microspores embryo-sact, and their macrosporangia ovules, a terminology which very nearly expresses our present view of their hom logics as established by Hofmeitter Nagel discovered the spermatozoids of these plants as well as

sugeri ossovered the spermanucolos of traces pairs as well as the probabilism and archegorian, but he shows the greatest reserve in correcting Schilden's extraordinary mittakes. It is worth remarking that at this early period the homology of pollen-grains with spores was generally admitted, and in first we wonder how this true result could have been arrived at hist we wooder how this true result could have been arrived at so prematurely. Here again the Schledenian theory affords the explanation. The pollen grain was regarded at a spore, which on germination produced the embryo-plant, not as do the spore of Cryptogams in the open sir, but within the embryo sac of the route. This conclusion was of course strengthene! by a mor-legium the argument drawn from a comparison of the mode of

legitimate argument drawn from a comparison of the more or origin of polling grains and spores.

A less fortunate result of the theory asperas in a poper.

A less fortunate result of the theory asperas in a poper.

Blatter "Nagel here erroneously attribute to the stem and its branches an endogenous origin. That this holds good for the primary aris, he proves by stating that it is derived from the polling praise, which itself arises endogenously within the ambier? also results in the state of bottomical operations during the sorbite salts results into the state of bottomical operations during the carlier

pollen gran, which itself armes endogeously within the anther?

pollen gran, which itself armes endogeously within the anther the pollen the polen the pollen the pollen the pollen the pollen the pollen the pol

on account of their superficial resemblance to the spore-tetrads of the higher Cryptogams The carpospores, which are the real sexual products, he regarded as gemme like those of Marchantsa, with the cups of which he compared the cystocarps Sich views were excusable at that time, but Nageli, as we shall see, adhered to them later on with excessive pertinacity.

Nageli was perfectly acquainted with the conjugation of

Desmids and Zygnemaceæ and imperfectly with the fertilization of Vaucheria, but he imagined that these processes were too in

or vaucnerss, out ne imagined that these processes were too in-constant to be regarded as sexual.

Nageli was at that time much more successful in dealing with the regetative organs of the Algze, and he rightly protested against the generalization current down to out own day, that

all Algae are destitute of leaves

His conviction that the Alge are without exception sexless led him in 1849 to reject Decuisne and Thuret's discovery of the spermatozoids of Fucus, which he regarded as spores. Of his spermatozoda of Iwoin, which he regarded as spores Of his inter algological papers, the most important is that on the Ceraniacese, published in 1601. In this the procupas and crinckgrages, the rest femals organ, are described and accurately still maintained his old view of the sexuality of the tetraports. The whole credit of the discovery of the real variet of the tear that the contract of the contract of the contract of the The "Pflanerapproplogogethe Unterschungen" of Nagel and

Cramer (1855-8) contain among other papers of importance Nageli's luge work on starch grains (about 600 quarto pages '), which is of great general value as embodying his views on the growth of starch and cell-wall by intussusception and on the molecular structure of organized bodies. For many years this molecular structure of organized bodies. For many years this micellar theory, as it was afferwards called, was regarded as Nageli's greatest achievement. Sachy, in 1875, said in his "Ilistory of Botany". "Nageli's molecular theory is the first successful attempt to apply mechanico physical considerations to the explanation of the phenomena of organic life." More recent i-esearch has shown that this attempt, life its predecessors, was premature, and though. Nageli's ingenous and carefully elaborated hypotheses must still arouse our admiration, we can scarcely now regard them as having added must lo our knowledge either of the growth or structure of organized bodies. The book on "Starch Grain," however, quite apart from theoretical considerations, will always remain a mixvellous and discriptive matter in addition to the specializations which have made it famous. The micellar theory was further devoted in sub-equient papers "on the behaviour of polarized light towards vegetable organisms" (1862), all "on crystalloid proton bothes" (1862), and "on the internal varieties of professed form in the important work on the intero-cope, published by Nagel and Schwenderer in 1877. elaborated hypotheses must still arouse our admiration, we can

perfected form in the important work on the micro-cope, pub-ished by Nageli and Schwendener in 1877. The papers in the "Physiologische Untersuchungen" bear the name of Nigeli or of Cramer respectively, but it appears that they mutually assisted each other throughout, hence it is not out of place to mention here Cramer's fine researches on the apical growth of Equiscium, which to this day serve as a model (rarely approached) for all such investigations

No sooner were these investigations with Cramer completed than another great undertaking was commenced in the publica tion of the "Beitrage zur Wissenschaftlichen Botanik" (1858-68) This began with the great paper "On the Growth of Stem and Root in Vascular Plants and on the Arrangement of the Vascular Bundles." This is the most important of Namel. This is the most important of Nigeli's purely ananot too much to say that the bulk of our knowledge of the disnot too much to say that the bulk of our knowledge of the dis-tribution of vascular tissues in plants still depends on this work. Other valuable papers in the "Bettrage" are those on the use of the polarizing meroscope, on the growth in thickness of the Sapindacee (another ideal pattern of anatomical research), and on the origin and growth of roots, in which stil i tgtgelo-coperated. Until the quite recent work of Van Tieghem and Doultot, this was undoubtedly the most important investigations. on the subject.

Among Nageli's later works there are two which have had a

lasting influence on our views as to the biology and physiology of the simplest plants. In "Die niederen Pilze" (1877) he treats of moulds, yeasts, and bacteria in relation to infectious diseases and hygiene. In this work an excessive scepticism is displayed as to the existence of definite species among the lowest organisms, such as bacteria. There is no longer any

doubt that species are neither more nor less distinct a these simple beings than among the higher plants, but Nageli did a real service in showing that each of these species may appear in a number of morphologically and physiologically

appear in a number of morpuosage...,

"Medification form."

Nagelis "Theorie der Gabring "(1879) demonstrated the
relation better the moderne of continuous and respiration,
relation to the moderne of formation and respiration,
of the moderne of the moderne of the morpuous
which, to use the words of Prof. Vines, "Iwng protoplasm,
which, to use the words of Prof. Vines, "Iwng protoplasm,
besides undergoing decomposition in certain substances which are brought within the sphere

"" in flancate."

It remains to consider briefly an aspect of Nageh's work, which is from some points of view the most interesting of allnamely, his relation to the theory of descent. The elaborate observations on variable species, especially in the genus Hiera-crum, which Nageli carried on throughout his whole life, side by

coun, which Nageli carmed on throughout his whole life, side by side with his thirotogical and physiological work, specially qualified him to take up an independent position with reference to the problems of evolution. In his paper, "The Rastate for the frequency of the contrastion of the light of Darwin's work. It has belief, however, in the origin of species work. It is also the forest of the contrastion of the contrastion of the contrasting of to accept it as antorsing a sufficient explanation of evolution. He believed that variation has a definite direction, always tending towards the greater complexity and perfection of the organism (Vervollkommungstheoric). On this view the development of the race, like that of the individual, has a definite course as signed to it beforehand. He protests that there is nothing supernatural involved in this doctrine, and that it does not He protests that there is nothing

supernatural involved in the decrine, and that it does not moce-waitly require soldien transformations. On this latter question, however, he species very uncertainty, and states that question, however, he species very uncertainty, and states that question, however, he species very uncertainty, and states that the state of the species of the species

But, whatever view may be taken of this speculation, it must be admitted that Nageli saw clearly the great fact—since brought be admitted that Nageli saw clearly the great fact—since brought home to us by the works of Westmann and his school—that the causes of variability are internal to the organism. This important doctrine, based on original experiments and observations, is maintained in a paper entitled "Ueber den Emflussusverer Verhaltnisse and die Varietatenbildung im Pflanzeir-reiche" (1863). He shows that "the formation of the more or less constant varieties or races is not the consequence and the iess constant varieties or races is not the consequence and the expression of external agencies, but is determined by internal causes?, while the modifications directly produced by external influences are inconstant, and do not give rise to varieties. We think it must be allowed that, on this essential point, Nageli was at that time somewhat in advance of Darwin himself. Other works of that period deal with the laws affecting the

distribution of species, and with the phenomena of hybridiza-tion. In the "Theore der Bastardbildung" (1866) the peculiarities of hybrids are explained as due to the favourable or unfavourable changes produced by crossing, in the internal coadaptation of the organs of the offspring.

A paper on the social origin of new species (1872) results in the conclusion that groups of new forms are likely to asise simultaneously, rather than isolated new species.

Finally, something must be said of the great work published in 1884, "Die mechanisch-physiologische Theorie der Abstam-mungslehre," which states at great length Nageh's final con-

c'usions as to evolution and heredity The fundamental idea of this weighty work is the conception of the Idioplasm, namely, of a definite portion of the general protoplasm, to which alone is This idea, committed the transmission of hereditary characters committed the transmission of hereditary characters. This idea, as Weimman points out, is a fruitful one, and will hive, and is indeed incorporated in all recent theories of heredity. Nagelis peculations, however, as to the details of the distribution and molecular structure of this thoplasm are of much more doubtful value, and rest on no firm basis of actual observation.

Nageli rightly argues that the character of the fertilized egg must be determined by a minute amount of idioplasm and must ue determined by a minute amount of idiophasm and not by the cytophasm generally, because the characters of the male and female parent are on the average equally represented in the offspring in spin of the enormous difference in the bulk of the cytophasm of operantozoid and ovum

It was only, however, after the idioplasm had been identified by Weismann and Strasburger with a detinite constituent of the

by Weismann and Strasburger with a definite constituent of the nucleus that the theory acquired a positive basis, Nagel in the "Abatammunglehre" points out that fertil ration can only consist in the direct union of solid displaymic bodies, and this on theoretical grounds arrives at a conclusion which has been fully confirmed by the observations of Van Benc-den. Strasburger, and Guignard He also shows that while in the higher organisms idioplasin alone is necessarily transmitted from parents to off-pring, in the increase of the lower plants and animals by division, the descendants acquire a share of the nutritive protoplasm also. Hence in the latter the conditions of tive protoplasm also Ilence in the latter the conditions of cultiue may directly iffect the descendants, as Nogeli found in the observations on bacteria. The conditions of the continuity of the continuity of the condition of the continuity of the germ plasm, as brought forward a year later, though on other points there is a wide divergence of opinion Nageli massis in his preface to this book, that the subject

of heredity can only be authoritatively treated by a physiologist, and he no doubt regarded his micellar theories as an important contribution to the question. In this his view is some what one sided, and as a matter of fact all recent advance in our knowledge of the essential points in reproduction has

come from the morphological side.

come from the morphological side.

Nageh's attitude towards the question of spontaneous general Nageh's attitude towards the question had no donice as control of the spontaneous origin of many bungs, and thought that the could be experimentally demonstrated. In 1865, he gave up the experimental evidence, but believed in the origin de news at all poochs of simple vegetable cells. In the "Datamaning when" he still maintains that spontaneous generation is constantly in progress, but no longer holds that even the lowest known organisms can arise in this way. His supposed primitive living things (Problem) are as much more simple than bacteria, as these are more simple than the highest animals or plants

As regards he causes of evolution, Nageli in his great work opens to limit the field of natural selection even more narrowly than in his earlier e-says. Its function, according to his later views, consists in the separation and definition of races by later views, consists in the expansion and elemition of races by the elimination of ill adapted forms, rather than in determining the origin of the races themselves. In a brilliant illustration be preture natural selection as pruning the phylogenetic tree, though powerless to cause the putting forth of new branches. He still regards evolution as a necessary progress towards perfection determined by the constitution of the organism itself, and more

especially of its idioplasm.

This view is only needed if we assume with Nageli the existence of purely morphological characters—of characters, that is, which are not, and never have been, of the nature of adaptalions It appears to us to have been sufficiently shown by Prof Welsmann and others that the existence of such characters is an unnecessary assumption As biology advances, we learn every day the function of characters which had before appeared to us to be useless, and the whole tendency of investigation is to prove that all characters what so ever are either of direct use to their present possessors or have been inherited from ancestors, to whom, at the time when they were acquired, they were equally advantageous. It would be difficult to cite a stronger instance of a "morphological character" than the alternation of generaon a "morposogical character" (has the alternation of genera-tions which to clearly characterize the higher cryptogans. Yet it has been lately shown by Prof. Bower that this may well have been an adaptive character at its first origin, the sporophyre being adapted for taking possession of the dry land, while the oophyte, owing to the mode of fertilization, was compelled to retain a lovely and semi-aquatic habit

We have given a very incomplete and imperfect sketch of the life-work of one of the most illustrious of that illustrious band of botanists to whom the chief advances of our science are due of botansist to whom the chief advances of our science are due Much of his work has of necessity been left quite unnoticed But on even a cur-ory glance through the wittings of Nagch the conviction is foreed upon us that he was a man not only of exceptionally wide scientific and philosophical training and of exceptionary wide scientific and philosophical training and of great literary power, but also one of real genus, and as far removed as possible from that narrow specialism which is the breetting vin of so much modern scientific effort. The judgment of Nageli's colleague, I'rof Cramer, that he was "a truly cannot be dismissed as the exaggerated language of great man. great man, cannot be distinsed as the congression important personal affection, but expresses a truth. Though some of his theories may be abandoned, a vast sum of permanent achievement will always remain, and the influence of Nageli on the ment will always remain, and the tombelse age future of our science will be powerful and lasting

UNIVERSITY AND EDUCATIONAL

INTELLIGENCE

Oxf ORD - Full term commences on Saturday, October 17, The following lectures in science generally have been advertised -

The Savilian Professor of Geometry (J J Sylvester) will lecture on surfaces of the second order, illustrated by the models with which that department has been supplied at the request of the Professor

The Professor of Astronomy (Rev C Pritchard) proposes to lecture on the methods of determining astronomical constants, and offers practical instruction with the transit circle and solar spectroscope Rev Bartholomew Price (Sedleian Professor of Natural

Philosophy) lectures on hydromechanics
The Professor of Experimental Philosophy (R. B. Clifton) will lecture on electricity, and instruction in practical physics is offered by Mr. Walker and Mr. Hatton at the Clarendon offered by Mr

offered by Mr. Walker and Mr. Hatton at one Custension Lalioratory. Tectures in mechanics and experimental physics are offered by Rev. F. J. Smith, at the Millard Laboratory. The Waynfere Professor of Physology (J. S. Burdon-Sanderson) will lecture on the subjects required for the final examination in the School of Physiology, and Mr. Dixey will lecture on the school of Physiology, and Mr. Dixey will lecture on the School of Physiology, and Mr. Dixey will lecture on the school of Physiology, and Mr. Dixey will lecture on the school of Physiology, and Mr. Dixey will lecture on the school of Physiology.

tion in the School of Physiology, and Mr Dixey will fecture on histology Practical instruction on this latter subject will be given by Mr Kent In the subject of Chemistry, the Waynflete Professor (W. Odling) will fecture on animal products, while the Aldrichan Demonstrator (W. W. Fisher) will give a series of fectures on

Dimonstator (W. W. Fisher) will give a series of lectures on the non-incidial celements. Mr. J. Wattis lectures on organic chimistry, and the instruction in pizaclical work is under the supervision of Mr. Watts, Mr. Vicey, and Mr. J. E. Marsh. The Depaty Linacer Piofessor of Human and Comparative Anatomy (E. Ray I ankestey) offers a course of lectures on comparative anatomy and embryology. This course is intended for seniors. There will viso be, a junior course for beginners and candidates for the preliminary examination in animal morphology conducted by the Deputy Linaure Professor and Di W B Benham This last-named gentleman will also lecture on the Chatopoda

The Professor of Geology (A. H. Green) offers two courses of lectures, one on physical, the other on stratigraphical

The Reader in Anthropology (E. B. Tylor) will lecture on the origin and development of language and writing The Sherardian Professor of Botany (S. 11 Vines) lectures,

this term, on elementary botany
The Hope Professor of Joology (J. O Westwood) lectures and gives informal information upon some of the orders of

Arthropoda
In the department of medicine, Sir H W. Acland, Bart gives informal instruction on modes of medical study. instruction is given at the Museum, where arrangements will be instruction is given at the Museum, where arrangements will be made for one or more demonstrations in illustration of subjects bearing on public health Dr. Collier and Mr Morgan give demonstrations for the Professor on Medical and Surgical Pathology. The Lichfield Lecturer in Clinical Medicine (W defining and the control of the cont

course of lectures on human osteology, and a series of dem

course of lectures on human osteology, and a series of demon-strations will be arranged to meet the requirements of those working in the department. The dissecting room will be open duity for precisits work and instruction ford College, has been nominated Vice-Chancellor for the enasing year. A mathematical fellowhap has been awarded at Merton College to Mr. Arthur Lee Dixon, B.A., formerly scholar at Worcester College. Mr. Dixon was placed in the first class both at Moderations and in the final Mathematical Schools. It obtained the Journ Mathematical Schools in 1897 and the Senior Mathematical Scholarship in 1891. Also at Corpus Christi College a mathematical fellowship has been awarded to Mr. Arthur Ernest Jolliffe, scholar of Balliol College. Mr. MY Arthur Ernest Jolline, scaoiar of Balioi College. MY. Jolliffe was placed in the first class by the Mathematical Mode-rators in 1889, and in the first class by the Examiners in Scientias mathematicis et physicis in 1891. He also obtained the Junior Mathematical Scholarship in 1889.

CAMBRIDGE,-The erection of the Newall telescope is nearly completed Prof Adams was able to use it for the first time last week, and took an observation of Neptune.

Prof Ewing announces that the new Engineering Laboratory is ready for use, and will be occupied this term
Mr. F. Blackman, of St. John's College, has been appointed

Mr. F. Blackman, of St. John's College, has been appointed Demonstrator of Bolany.

By the return of Prof Jebb, the University enjoys the distinction of being represented in Parliament by a Senior Classic (Dr. Jebb) and a Senior Wrangler (Sir G. G. Stokes).

Sixty-four candidates entered for the examination in sanitary science held last week. Of these forty three have passed both parts of the examination, and receive the diploma in Public

Health The Lecturer in Geography (Mr Buchanan, F R S) will this term lecture on physical and chemical geography, with especial reference to land surfaces and their development under

especial reference to land surfaces and their development under climatic and other agencies

The vote in the Senate on the question whether a syndicate shall be appointed to consider alternatives for Greek and Latin in the Previous Examination will be taken on Thursday, October 29, at 2 p.m.

University Extension —It is announced that Mr T. D. Galpin, of the firm of Cassell and Co., Limited, has offered to the Dorset County Council the sum of £1000 to be invested for the surfect county council the sum of £1000 to be invested for the purpose of providing scholarships to send natures of Borset to the Summer Meetings of Oxford and Cambridge The scholarships will be awarded to the writers of the best essays, and it is proposed that the examination should be conducted by the University Extension Committee of the Oxford Delegates of Local Examinations. The scholarships are to be awarded without distinction of sex, or any political, sectarian, or social distinction whatever

SCIENTIFIC SERIALS

THE American Journal of Science, October 1891 Some of the possibilities of economic botany, by George Lincoln Goodale. This is the Presidential address delivered before the American Association for the Advancement of Science, at Washington in August last.—On the ritality of some annual plants, by T Holm.
The author cumerates several species of plants which show a tendency to vary from annual to biennial or perennial.—A tendency to Vary troot annual to incensial or perennial,—method for the separation of antimony from anceine by the simultaneous action of hydrochloric and hydrochloric acids, by F. A. Gooch and E. W. Damner —Notes on allotropic silver, by M. Carey Lea The blue form of allotropic silver is mainly considered. The action of light on this form is remarkable, for its effect is first to increase the sensitiveness to reagents and then to completely destroy it. This reversing action is analogous to that which light exerts upon silver bromide. Mr Lea has also examined the point as to whether in the reduction of silver, the examined the point as to whether in the reduction of salver, the allotropic or the normal form is produced, and he finds that when the silver passes from the condition of the normal salt or oxide to that of the metal, the reduced silver plays appears in the ordinary form. But when the change is first to sub oxide or to orunnary norm. But when the change is next to sub oxide of to a corresponding sub-sait, the silver presents itself in one of its allotropic states.—Structural geology of Steep Rock Lake, Ontaro, by Honry Lloyd Snyth.—On the so called amber of Cedar Lake, North Saskatchewan, Canada, by B. J. Harrington. The ream or "retimite" examined by the sattlor had a hardness

of about 2'5, and a specific gravity 1'055 at 20° C. An analysis gave for 11s composition, carbon 80'03, hydrogen 10'47, and oxygen 9 50—Geological horisons as determined by vertebrate fossils, by O. C. Marsh. The method of defining geological fossils, by O, C. Marsh. The method of defining geological horzona hy vertichnet (ossils was first used by the author in 1877), and appears to afford the most reliable evidence of climatic A section accompanies the paper representing, in their geologi-cal order, the successive strata at present known with certainty from characteristic vertichrate fossils.

SOCIETIES AND ACADEMIES.

PARIS

Academy of Sciences, October 3 .- M. Duchartre in the chair —On the variations of composition of Jerusalem artichokes from the point of view of mineral matters, by M. C. Lechartier. The author gives the results of some investigations made at the The author gives the results of some investigations made at the Reneas Agracianus Station, on the culture of articholdes in Reneas Agracianus Station, on the culture of articholdes in flustness as indicated by cultures on similar plots for three con-sective years—Otherwistons of Wolf's comet made with the great telescope of Toulouse Observatory, by M. E. Coaserat, from August 13, to September 28.—On the value of electrostatic tension in a dielectine, by M. L. de la Rive —On the almost laceous existence, in culture of Saphylosogie, pagings, of a taneous existence, in cultures of Staphylucolus process, of a vaccine substance capable of being precipitated by alcohol, and of a substance soluble in alcohol, by MM A. Rodet and J. Courmont.—On some parasite Copepods, by M Engène Canu—Observations of the fall of a solar prominence into a spot, by M E L Trouvelot. The observations relate to some remarkable luminous filaments occurring in a group of spots from August 6 to August 10

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS, FAMPHLETS, and SERIALIS RECEIVED.

Ibs Physical Colory and Georgiesy's riliabile 2 Ethica and editions of the colory and the control of the colory and the colory an

CONTENTS.	PAGE
Physical Chemistry By J W. R	. 561
United States Fish Commission Reports	562
The Catalogue of the Washington Medical Library	. ,,,,
By Dr. A T. Myers	563
Our Book Shelf:	5.5
"Dictionary of Political Economy"	564
"South Africa, from Arab Domination to British	
Rule"	. 564
Letters to the Editor:-	. 304
A Pink Marine Micro-organism -Prof. W. A. Herd	
man	. 565
Advertisements for Instructors —M	565
"Rain making."-W R Pidgeon	. 565
Alum Solution,—Shelford Bidwell, F.R.S.	565
B Sc. Exam. Lond. Univ 1802.—Edward J	303
	. 565
Some Notes.—J. J. Walker, F.R S	
The Molecular Process in Magnetic Induction	. 565
(Illustrated) By Prof J. A Ewing, F.R.S	. 566
The Sun's Motion in Space. By A. M. Clerke	
	572
Our Astronomical Column:	· 574
Measurements of Lunar Radiation	577
Two New Variable Stars	. 578
A New Asteroid	. 578
A New Cornet	. 578
The Iron and Steel Institute	. 578
Carl Wilhelm von Nagel: By Dr. D. H. Scott .	. 580
University and Educational Intelligence	. 583
Scientific Serials	. 584
Societies and Acedemics	584
Books, Pamphlets, and Serials Received	. 584

THURSDAY, OCTOBER 22, 1891

RUDOLF VIRCHOW AND HIS COUNTRYMEN

THE German people are to be congratulated on the brilliant way in which the seventieth birthday of Prof Virchow was celebrated last week in Berlin 'We say the German people, because the entire nation associated itself with the scientific societies in doing honour to the illustrious investigator of whose achievements it has for many a day been so justly proud Everyone who devotes the slightest attention to science is aware that Prof Virchow occupies a prominent place among the foremost intellectual leaders of the present age. As the Times has said, "So much has he done, and so thoroughly has he done it, that it is difficult for this generation to apprehend the full magnitude of his work Open a book on medicine, and especially any volume on pathology, composed, it matters not much where, before Virchow began his observations, and compare it with one composed with the light of his endless investigations to guide the author a veritable revolution in conceptions and terminology has taken place, at every turn you read, 'All this is understood since Virchow wrote,' or words to that effect, and you are referred to his inultifarious 'epoch-making' articles scattered through many professional and technical periodicals" By his great principle, "Omnis cellula ex cellula," he made a contribution of the highest importance to biological science, and his conception of cellular processes introduced wholly new and most fertile ideas as to all the phenomena of disease The science of pathology as it is now understood and taught we owe, indeed, mainly to his insight and labour, and the recent advances which have been made in it by other explorers have been made on the lines he has traced If Prof Virchow had done nothing else for science, this alone would have secured for him imperishable fame. but his energies are so varied that it has been impossible for him to content himself with one department of re-As a student of archæology, ethnology, and anthropology, he is hardly less eminent than as a nathologist. In all these sciences he has marked an era by his writings, and by the personal influence he has exerted on the Berlin Gesellschaft fur Anthropologie, Ethnologie, und Urgeschichte, which he founded in 1869 In practical life, too, as a member of Parliament and of the Municipal Council of Berlin, Prof Virchow long ago made himself a great power in Germany. He has missed no opportunity of expounding the laws of public health, and of insisting upon their importance, and a striking testimony to the value of his work in this direction may be seen in the improved sanitary condition of the German capital

To the Germans it seemed perfectly natural that, when so illustrious a man of science completed his sevenieth year, the nation should offer its congratulations on the splendid results he had accomplished Would an English man of science of corresponding intellectual rank have received similar tokens of popular gaitatide/jahl respect? Unfortunately, the question answers itself, and it would be well worth the while of Englishmen to consider carefully the causes which have led to the contrast in this respect between them and their German kingfolk. It

may be said that Germans are more demonstrative than Englishmen, but this by no means accounts for the very different ways in which scientific discoverers are treated in the two countries. The real root of the difference hes in the fact that the importance of science is much more highly estimated in Germany than in England, and especially by the Governments for several generations, the various German Governments have done everything in their power to foster scientific investigation. With this object in view, they have spent money freely and wisely, allowing themelyes to be guided, not by impulse or caprice, but by the advice of men of wide experience and knowledge were quick to note the influence which might be exerted on industrial development by technical education, and the result is that Germany has for some time had as in inv technical schools and colleges, adequately equipped, as are necessary for her wants. We need scarcely say how very different is the spirit that has hitherto animated our own Government. The idea of most English statesmen about science seems to be that it is a bore and a nuisance, and that the less they have to do with it the better for themselves and the public. Liven for technical instruction they declined to in the provision, until, by an accident, the present Government found itself in possession of a fund which it did not know how to get rul of except by giving the County Councils authority to use it for the establishment of technical schools and classes Is it surprising that when their rulers act in this way the mass of the British people should be utterly indifferent to scientific progress? The Germans have been accustomed all their lives to see science encouraged, and all classes learn therefore to regard it as an essential factor in the evolution of their national life this week they have had a fresh example of the respect in which science is held, the Emperor having appointed Prof Helmholtz a member of the Privy Council, with the title of Excellency In the telegram announcing to Prof Helmholtz the honour conferred on him, the Emperor took occasion to refer with pride to the lustre shed on Germany by his scientific achievements. Nothing of the kind is ever done here

The influence of education must also, of course, be taken into account. There is still some dispute in Germany, as in other countries, about the exact place which properly belongs to science in general education, but there is no dispute at all as to the importance of training children to recognize the benefits which science in all its branches has conferred on mankind, over in the "Realschulen" an excellent scientific training is provided for those who either have little power of appreciating classical literature, or who are likely to be best fitted for their future work by the study of science And in elementary schools an effort is everywhere made to interest children in the facts and laws of nature, and to give them some conception of the objects and methods of scientific inquiry. How far we lag behind the Germans in these respects all true "educationists know We have made only a beginning in the use of science as an instrument of popular culture, and many years, we fear, may pass before we shall have applied it sufficiently to render scientific conceptions a really vital element in the intellectual life of the community.

It is not for the sake of men of science that we desire to see more widely diffused an intelligent appreciation of their work A celebration like that of last week necessarily brings with it sad as well as happy reflections, "After all," said Bluntschli, the famous jurist, on a like occasion, "it is an end, not a beginning" Prof. Vnchow is fresh and vigorous, and the world may still reasonably expect from him much sound work, but we may be sure that, in responding to congratulations, he had a little of Bluntschli's feeling, and it is possible that, if he had consulted his own wishes only, he would have preferred to celebrate his seventieth birthday more quietly. But it is good for a nation to express on such occasions the admiration and reverence excited by a long and great career. The mere fact that men desire to honour one whose title to distinction is that he has advanced human knowledge proves that they have interests higher than those of a material character, and it inevitably tends to deepen and strengthen the best and most enduring of their unpulses We should be glad, therefore, if Englishmen had as strong a wish as Germans to display a hearty appreciation of the triumphs achieved by their great scientific thinkers That would be the most effectual of all proofs that they had begun, as a people, to understand how momentous is the part which science has played, and must continue to play, in the modern world

586

I-LECTRIC LIGHT FITTING -GOOD AND BAD

Llectric Light Fitting a Hand book for Working Electrual Engineers. By John W Urguhart (London Crosby Lockwood and Son, 1890)

THIS book is exactly what it professes to be-a practical book for practical men--and is vastly superior to "Electric Light," by the same author The detailed instructions given in the first 42 pages, on the erecting, managing, and repairing dynamos, are admirable, and are not to be found in any other book in the English language The young electrical engineer will find just the information he needs how to fit up a large dynamo when received in parts from the makers, how to prevent the commutator becoming rough in use, exactly what to do if it be rough, how to prevent sparking at the brushes. how to attach a new commutator and make joints in the armature wires; what to do if the dynamo heats; and how to get over the various other difficulties met with in the dynamo-room

The author, in these early chapters, and indeed throughout the book, uses the expression "constant current" for direct current, and although the action of the regulators of the Brush and of the Thomson-Houston constant current dynamos is correctly described, and clear illustrations given of their construction, the reader is left in the dark as to the exact use of these regulators. Or, rather, the only definite statement as to the function of the Thomson-Houston -regulator, that it is "for causing the machine to evolve more or less current as required. is certainly much more likely to lead the reader wrong than right Further, to say that "in Siemens's alternator, or the Ferranti dynamo, 'lead' must be given to the brushes"

alternate machines have no commutators, but only collecting rings), will probably destroy the correct impression about lead which the practical man may have derived from reading the previous page

OCTOBER 22, 1891

In spite of these defects, however, chapter i, is excellent, but we cannot speak quite as highly of chapter ii., "On Localizing Dynamo Faults, and Observations respecting Accumulators." In describing the test for the existence of leakage between the iron framework and the earth, the author makes an error that we have met with before, in stating that a deflection of a galvanometer whose ends are connected respectively with the iron framework and the earth indicates leakage between these two. This is equivalent to saving that a conductor not having the potential of the earth proves that it is in connection with the earth In the "Hints to Accumulator Attendants" there are some very useful suggestions, but the instructions for deciding when an accumulator is charged confirm the impression we gave when reviewing the author's "Electiic Light," that the author had not derived his knowledge of storage cells from a practical acquaintance with them. For he says that they must not be so much discharged that they cease to give any current; and in the chapter on "Switch Board and Testing Work," that the E M F of accumulators, in discharging, should never be allowed to fall below o s volt per cell. Such instructions are about as useful as saying that a horse should not be worked until he dropped, for if accumulators were to be regularly discharged until their E M F fell to a value even three times as great as the limit prescribed by Mr. Urguhart, they would be speedily ruined

Why these two statements about the discharge limit of storage cells should be given in different parts of the book, with information about "Running Dynamos in Parallel." the "Periodicity of Alternators," &c , inserted between, we do not know. In a somewhat similar way, the author returns again and again in different parts of the book to the subject of insulation resistance Lach time, no doubt, valuable information is given; but why not have put it all together, so that the working electrical engineer could have at once read up the subject, without having to turn up a number of references. This sort of scattering of information runs through the whole book, and rather suggests the idea that no very serious attempt was made to sort out information written down by the author as it occurred to him at different times.

We do not think that the explanation on p. 54-"alternators work according to a 'phase,'" is very lucid, Further on, the author says the number of phases per second is the periodicity, and later that periodicity and phase are the same thing. On p. 51 we are told "a fall of five volts in a hundred affects the brightness of the lamps,' from which a person might easily obtain the wrong impression that a fall of two or three per cent. was not observable, and be astonished when he read, on n. 72, "that a fall of five volts in a hundred in the working pressure will cause lamps which burn brightly at a hundred volts to become very dull." He would also not be able to reconcile the statement, "upon well conducted systems the pressure upon the mains is never allowed to vary more than one-half per cent.," with the variation of 2 per cent. up and 2 per cent. down, which is allowed (an instruction, of course, quite impossible to carry out, as | by the Board of Trade Nor is it possible to understand the rule with reference to the wiring of a house, "It should show an insulation resistance of at least 1 meg-ohm per lamp," since this would make the insulation of an installation the higher the greater the number of lampholders, whereas of course, as a matter of fact, the very reverse is the case.

Chapter iv. on "Arc Light Wiring and Fitting," is full of practical suggestions: the instructions on the trimming of arc lamps, and the precautions that ought to be adopted in order to keep arc lamps in good working order, will greatly help the young engineer when he is first put in charge of arc lamps It is a pity, however, that when the author is speaking of supplying constant current to a variable number of arc lamps running in series, he should say, "but the shunt or compound-wound machines are supposed to regulate themselves, which they very often fail to do " For we never heard of a compoundwound machine, still less of a well-made shunt machine, which professed to produce a constant current when the external resistance was varied. And this mistake is emphasized in the next section, on running arc lamps in parallel, since, although it is quite rightly said of the attendant, that "his chief care is to keep the potential difference between the leads the same," Mr Urquhart states, "This is usually effected in part by the dynamo itself when a shunt-wound machine is used, or by regulating the speed", and he makes no reference here to the use of a compound-wound machine, as if it were not the special function of this type of machine to keep the potential difference between the mains constant.

There is a good illustration on p 107 of the Thomson-Houston lightning arrester, with an explanation of its construction, but no hint is given that the electric arc produced by the lightning flash is magnetically blown our and thus extinguished And in the large perspective illustration of a Thomson-Houston transformer, given in this chapter, the thickly insulated leads are shown with a thick copper conductor inside them, while the lightlyinsulated leads have a thin conductor, and since, in the description of a transformer, it is not stated that, besides transforming from a high to a low potential difference, this apparatus also transforms from a small to a large current, it would be quite possible for a beginner to read this book, and wonder why people went out of their way to construct dynamos to produce one or two thousand volts, and then had to employ special apparatus at the consumers' premises to lower this high potential difference. "It is usual to put the secondary circuit to earth," probably expresses the author's view (as it also does the reviewer's) of the proper way to guard against accidents being produced by a contact between the primary and secondary circuits of a transformer, but it certainly does not represent the ordinary practice.

The name "impedance coils" is suggested for inductive coils used to diminish a varying or an alternating current; but the necessity for this name arises from the expression "choking coils," which is commonly used in this sense, having been wrongly employed by the author for any kind of resistance coils, such as, for example, a non-inductive restance used with a steady current.

Chapter v., on "Wiring for Incandescent Lamps," abounds in useful hints, and is illustrated with several NO. I 147, VOL. 44

well-executed woodcuts. Admirable, however, as may be the switches, fuses, &C., constructed by Messrs Woodhouse and Rawson, the succession of illustrations with the names of that firm underneath tends to give the impression that there are no other manufacturers of such apparatus. Surely the weighted fuses made by the Acme Works, the switches of Messrs Stemens—which provide a metallic circuit for the current but expend the flash, produced by opening the circuit, on carbon contacts—and the switches of Messrs Crompton, were worthy of a reference

If the well thought out precautions detailed in " Methods for Running Wires" had been followed in all the wiring of houses that has been carried out during the past few years. we should not have heard of those very justifiable complaints of occupiers who, after taking the lease of a house, temptingly described in the agent's list as fitted throughout with the electric light, find that they have to entirely re-wire the house before the insurance office will allow the current to be turned on. We thoroughly agree with the author that " There is one leading maxim for a contractor putting in electric light, and it is to avoid contracts that do not allow of the best class of material and labour being used throughout" We should also like to impress on the general public that the plummer, or the carpenter's handy man, is not, as they seem to think he is, any more capable of fitting up an electric installation than he is of setting a broken leg

We do not understand why, as a definition of "cleat wiring," Mr Urquhart says, "This means uncovered wires run &c " . surely cleats are ficulently employed to hold down covered as well as uncovered wires. On p. 185 the temperature is not stated at which "the ohm is the resistance offered by a column of mercury 1 square millimetre in cross section and 106 centimetres long." Power and work are said to be synonymous, and footpounds said to be analogous with volt-amperes output of 1000 watts "is called under the Board of Trade regulation a kelowatt," whereas the late Sir William Siemens, and not the Board of Trade, originated this name "As lamps are now made, each would probably give a light of 20 candle-power, the watts per candlepower being 2 5" Would that we could buy glow lamps which had a decent life, while needing only 25 watts per

Sir William Thomson's rule about the right sectional area to give to a conductor "is only a suggestion made for the protection of buildings from fie." We thought everyone knew that it was a rule for settling the thickness of the conductor with which maximum economy could be obtained

The rules about jointing leads are exact and valuable, we do not, however, like the general rule of using the body of a chandeher itself to serve as the return, and we think this rule ought to be followed only when the return were is throughout the installation an uninsulated one

Chapter vi. gives a good risumi of the prov and contregarding the use of the body of an iron ship as the return for ship lighting, while chapter vii. gives the substance of the rules issued by the Institution of Electrical Langineers, in connection with fire risks and danger to life.

MORE SUGGESTIONS FOR COUNTY COUNCILS,

County Councils and Technical Education By J. C Buckmaster (London Blackie and Sons)

U NDER the above tule Mr Buckmauter, who for turer, and organizer with the Scenec and Art Department, gives some statistics relating to technical education, and his views on the best way of utilizing the funds in the hands of County Councils. We need hardly say that, backed as they are by so long an experience, his opinions deserve the most careful and respectful consideration.

Briefly stated, Mr. Buckmaster believes in class teaching as opposed to lectures, and in utilizing as far as possible existing elementary and science and art teachers. "Unless," he says, "the sympathy of teachers and other educationists can be enlisted, the most carefully considered schemes of County Councils can only end in partial or complete failure." Again.

"Lectures by themselves are never to be highly valued as a means of ductation in all electure on science, to create and sustain an interest, you must be popular, and to do this you awould the complex difficulties of the science, which are often the only intellectual parts of P. Lectures, unless followed up by thought and reading on the part of those who hear them, fall as a means of education, &c., &c."

All this is excellent, and the warning is useful. But when Mr Buckmaster comes to the application of these principles he is not quite so happy. For example, he is unjust to the University Extension system, which he does not clearly understand, and treats as though it were mere popular lecturing, like the work of the old Mechanics Institutes Now, though we have no belief that the University Extension machinery can fill the place of elementary class teaching, we cannot accept the implied suggestion that courses of ten or twelve lectures (often arranged in sequences of two or three sets of twelve lectures), each lecture followed by a class for the more serious students, and by written paper work corrected by the lecturer, and the whole course tested by independent examination, form an engine of instruction scarcely above the level of a clever conjuror's performance

His constitutive suggestions are, first, to use elementary teachers to give object-lessons in simple science -a most useful proposal, about to be carried out in various counties as soon as the teachers themselves can be properly trained for the work, and secondly, to multiply science and art classes "The best technical instruction for some time will be a wider development and extension of the educational work of the Science and Art Department by means of night classes and continuation science and art schools" This depends, of course, on the meaning to be attached to "development." If it merely means multiplication, the statement is open to serious question No one can know better than Mr Buckmaster the special dangers attaching to the system which he advocates? the abuses which grow up round a system which makes the financial success of the class, and usually the salary of the teacher, depend on the result of an examination In our opinion, the machinery of the Science and Art

Department will long continue to be a most useful and important factor (though not to the exclusion of other agencies) in the development of technical instruction. But the present is the great chance to consolidate and improve, rather than merely extend the work. If the County Council funds are so granted as to correct the evils which inevitably arise out of s ch a system of payments on results as is adopted by the Department-if its control is used to render more effective the inspection as opposed to the mere examination of science and art classes-then the portion of the grant given to promote the work aided by the Science and Art Department will be well spent But no claim on the part of this or any other single agency to a monopoly of all technical instruction above the rank of that which can be given by the village teacher can be conceded. Mr Buckmaster does not in so many words make the claim, but he sometimes seems to imply it by minimizing the value of most other experiments which County Councils are attempting It is virtually a plea for educational bureaucracy against local experiment. But we have not yet reached the stage, if, indeed, we ever do so, when variety of experiment can be dispensed with. Some of the experiments will probably fail. But it is only by wide and free experimenting that the "fittest" will be discovered Mr Buckmaster has confined himself, probably on purpose, to the elementary branches of technical instruction, and is silent on its higher developments. Manual work he only just mentions, and not with much sympathy criticisms on the wood-carving taught by ladies in villages is not, perhaps, too severe, but it is strange that he does not give a hint that systematic manual training may be (as it has been for a long time in other countries, and lately in our own) made of real educational value a word is said of the worst defect of all in our educational system the want of good, cheap, secondary schools, which the present grant may do so much to icmedi

Though, however, Mr Buckmaster takes a rather cramped and narrow view of the outlook, his pamphlet is full of valuable, if rather partial, ideas

The pamphlet opens and concludes with some useful statistical and other information taken from various publications of the National Association for the Promotion of Technical and Secondary Education Readers who not know the source from which these pages are derived may be puzifed by a reference to "the Committee" (p. 41), which by some error in editing has been left still standing, without explanation, in Mr Buckmaster's pamphlet.

THE MISSOURI BOTANICAL GARDEN.

Missour: Botanical Garden Second Annual Report. By William Trelease. Pp. 188, Plates 48, reproduced Photographs 5, and Plan of Garden (St. Louis, Missour: Published by the Board of Trustees, 1891.)

THE Board of Trustees of the Missouri Botanical Garden have instructed the Director to edit for publication each year a volume setting forth the objects of the Garden and the School of Botany, and the results accomplished by each. The first volume of this series was issued in December 1890, and contained an account

of the Garden and School The present volume, therefore, really begins the series of annual reports, and together with the reports we have a revision of the North American species of Epilobium. In the earlier part of the book details are given of the appointment of six garden pupils to scholarships in accordance with a resolution adopted by the trustees at a meeting held in November 1889 Each scholarship conferred may be held by the recipient for a period not exceeding six years, subject to certain conditions. The holders of scholarships are renaid for their services to the Garden, and at the expiration of the six years are entitled to examination by the Garden Committee On passing such examination to the satisfaction of the Committee and Director, they receive a certificate of proficiency in the theory and practice of gardening The only scientific paper in the volume is, as we have just mentioned, a revision of the genus Epilohium, the American species occurring north of Mexico being those studied This genus differs from all the other capsule-bearing Onagracca, except the Califorman Zauschnerm, in having its seeds provided with an ample coma at the apex. While it reaches great development in New Zealand, Epilobium is essentially a genus of temperate and cold climates, and the most widely distributed species are those of Arctic and Alpine regions In Alaska a few such species occur, which are otherwise confined to the adjacent part of Asia More widely distributed Arctic-Upine iminigrants from the Old World to the New are E spicatum, E latifolium, E palustri, F alpinum, &c E hir sutum, E parvissorum, and E adnatum, also occur as accidental waifs. The genus passes into South America along the backbone of the continent, few members of this family extend very far across the Mexican boundary in either direction. The most interesting biological features of the genus are those connected with the means of vegetative propagation, pollination, and dissemination The contrivances by which species survive the winter. and are vegetatively propagated, in this respect attain an extreme degree of differentiation, one in particular having acquired aerial bulblets. The large flowered species appear to be regularly proterandrous, the duration of the dichogamy being brief in most of them, and the smallerflowered seem to be always synactic and self-fertile, although with the probability of frequent intercrossing by aid of insects attracted by the nectar which is secreted The genus is of no striking within the cally tube economic value The North American Epilobia have been mostly described by De Candolle, Torrev and Gray, Haussknecht and Barbey, the more notable works of more limited range being Hooker's "Flora Boreali-Americana," and Brewer, Watson, and Gray's "Botany of California," Prof Trelease in his revision enumerates 38 species, which number includes the following novelties . E holosericeum, E delicatulum, and E clavatum The well-known sections Chamanerion and Lysimachion are still adhered to, the latter, of course, being by far the larger In the analytical key the main divisions depend on whether the stigma is deeply 4-lobed or 4 cleft, or entire or only notched. Subdivisions are founded on whether the seeds are smooth, or papillately roughened The name E spicatum, Lam, is used instead of angustifolium, the typical angustifolium of Linnæus being,

according to Prof Haussknecht, what is commonly known as L. Dodones, Vill We are glad to see that Prof Trelease differs from Prof. Haussknecht in not adopting a new name for what is left of the original E alpinum The E albinum of Linnaus included with this E Hornemanns and E anagalishfolium, but we think that the name may well stand for one of the segregates genus Epilobium has always proved a difficult subject . and Prof Trelease is to be congratulated on his careful treatment, and successful arrangement, of the North American members The 48 plates will be found of great help to students of these plants, they are not quite of uniform merit, but, taken as a whole, they give the essential details, stress being laid on the varied form of the stigma and seed Additional illustrations are some well-reproduced photographs taken in the Garden, and a plan of the grounds (scale - ! a) in five sections

EGB

OUR BOOK SHELF

The Story of the Heavens By Sir Robert Stawell Ball. Eighteenth Thousand (London Cassell and Company, 1891)

In the preface to this edition, Sir Robert Ball remarks that he has taken the opportunity to "revise the work in accordance with the progress of astronomy during the last four years," and, generally speaking, new facts and theories are briefly referred to A few points, however, are hardly brought up to date For example, the spectium of the Andromeda nebula is said to be "a faint continuous band of light" (p 462), although it is now definitely known that this continuity does not exist We also find no reference to the many stars now known to have bright lines in their spectra. The author thus misses a chance of exercising his well-known descriptive ability in an account of the connection between such stars and nebule, the similarity of the two being so considerable that Pickering has followed Lockyer in arranging them in a single group. Dr Huggins's old view as to the coincidence of the nebula line with nitrogen is mentioned merely to be dismissed as erro-Why, therefore, is no notice taken of the suggested magnesium origin of the line—for, on any published evidence, the edge of the magnesium fluting is nearer the proper position than the nitiogen double? We would also point out that, according to recent observations, the apex of the sun's way is much nearer Lyra than Hercules Telescopic changes in comets are fully described, but the accompanying changes in their spectra are not touched upon. Motions of stars in the line of sight are considered; but not those of nebula, although Mr. Keeler's observations have been published for some In fact, it may be said that there is a tendency ume to eschew spectroscopic questions, and hence much of the most beautiful part of the story of the heavens is left untold.

Notes on Elementary Physiography By Horace C Martin. (London and Manchester John Heywood, 1891)

THE author has collected a lot of scraps of information from standard writers on physiographical matters, and has strung his gleanings together to form this book. And if he were an adept at compilation, and knew how to best arrange and connect facts, his plan of printing extracts verbatim might be commended. But when Mr Martin selects noise which by themselves are incorrect, and inter-

polates in others crude statements which render them redeculous, he does an injustice to the authors to whom he acknowledges his indebtedness, and he shirks responsiacknowledges his indededeness, and he sarris responsi-bility by saying that "these notes do not lay claim to originality" Could anything be more misleading than the following description of sun spots on p. 148? "They seem to rise suddenly to a great height, cool, and then sink back into the photosphere They are due to up-rushes of incandescent hydrogen, and are identical with the red flames seen during an eclipse." And the figure that accompanies this text cannot be a sun-spot at all, but must be something else inserted by mistake. Another blunder occurs on p 50, where a section of an intermittent spring is shown upside down. The figures are mostly very coarse and poor, especially the moraines on p 62, the section through a cinder cone on p 89, and one of a volcano on p 90, whilst the two figures of ocean bottoms on pp. 102 and 103 give a very wrong idea of their nature. There is, of course, a deal of information in the book, but no attempt is made to give it interest. In fact, although the author is a teacher of physiography, it is very evident from his work that he has not paid attention to the practical side of his science, or verified any of the phenomena he essays to describe As a book of reference the work before us is untrustworthy; and as a work for students of elementary physiography it is useless and much to be condemned

Thomas Sopwith, M.A., C.F., F.R.S., with Excepts from his Diary of Lifty wen Years. By B. Ward Richardson, F.R.S. (London Longmans, Green, and Co. 1891)

MR SOPWILL died in 1870 at the age of seventy-six. He was not eminent as an original scientific investigator, but was not emment as an original scientific investigator, but he was a man of great tugor and freehness of mind, and had won the affection of a wide circle of friends by his genal and happy temper. For many years he reasted at Newcastle as an eigeneer and tailway surveyor Afterwards he removed to Alienheads, where he served as the chief agent of M. T. W. Beaumont's lead-mines in Northumberland and Durham Dr. Kudandson's book will recall Mr. Sopwith vividly to the minds of his book win retail at rought any things which will be of interest even to readers who were not personally acquainted with him Duning the long period of fifty-seven years he kept a diary regularly, and of this, of course, Dr Richardson has made liberal use. The extracts show that Mr Sopwith studied closely the currents of scientific opinion, and formed his own judgment about them in a shrewd and independent spirit.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions ex-pressed by his correspondents. Nisther can he undertake to return, or to correspond with the winters of, regated manuscripts intended for this or any other part of NATURE. No notice is taken of anonymous communications.]

Electric Transmission of Power

Your article of the 1st inst. on the International Flectrical Ex-bition (p. 522), says. "In those days (before 1879) two wrong hibition (p. 522), says. "In those days (before 1879) two wrong notions misled people—the one, that the maximum efficiency of a perfect electromotor could be only 50 per cent; the other, quoting the remarks of Sir W. Siemens, 'in order to get the best effect out of a dynamo electric machine, there should be an external resistance not exceeding the resistance of the wire in the machine

These two notions are really one the first follows by immediate inference from the second.

Your article says a little further on . "At the British Associa-

tion in 1879, Prof. Ayrton exposed the fallacy of assuming that 50 per cent. was the maximum efficiency theoretically obtainable from an electromotor. This was perhaps the first time

NO. 1147, VOL. 447

that it had ever been suggested that the efficiency in electric transmission of power could be more than 50 per cent."
This is a markle as to instroid afet. Many years ago, I am a markle as to instroid afet. Many years ago, I am a mirror of the property to which he replied, "The maximum effect, in Ohm's theorem, does not mean the maximum work done by the oxidation of a given quantity of zinc, but the maximum effect obtainable from a given surface of zinc plates?" "I see," said I, "just as in the case of the steam engine, the problem of getting the maximum effects of the steam engine, the problem of getting the maximum engine. mum of useful effect from a given weight of coals is a different one from that of getting the maximum of power from a given area of useful.

This appears to be an instance of a truth being grasped by one of the great masters of science long before it passed into general teaching. And it is also an instance of a truth being so mistaken as to mislead. Ohni's law was evidently understood.

to bear a significance that it did not really bear
Belfast, October 13 JOSEPH JOHN MURPHY

[I hat Joule had clear and correct views regarding the efficiency [Lihat Joule had clear and correct views regarding in enuncincy of an electromotor driven by a voltaic battery was pointed out some years ego, being mentioned, for example, by Prof. S. P. Thompson in his book on "Dynamo Electric Makinney" But in the paragraph quoted by Mr. Nurphy from NAIVER of Cytober 1, the expression "electric transmission of power" had October 1, the expression "electric transmission of power" had reference to the combination of apparatus exhibited at the lecture in question—had, in fact, the meaning usually attached to this expression, wir the employment of a dynamic to convert mechanical energy into electric energy at one end of a pair of wires of some length, and the employment of a second dynamo at the other end of the wires to convert the electric energy back again into mechanical energy

Now, not only would it have been somewhat difficult to foretell what would be the combined efficiency attainable by the employ-ment of two dynamos as generator and motor, at a period " long before the dynamo was invented," but even down to 1879 no one had succeeded in practically transmitting power by means of this combination with an efficiency of as much as 50 per cent over a distance of even one mile

The only direct current dynamo in common use at that date was the series dynamo, and that machine, as is well known, differs radically in its behaviour from a voltaic battery. For while it is when a voltaic battery is developing a very small white it is when a voltate battery is developing a very small current that it gives power most economically to the outside Circuit, the senes dynamo, when only a very small current is passing through it, develops practically no electromotive force, no power, and therefore has a very low efficiency. Hence, although electricians were undoubtedly mistaken in facejung that there was a theoretical limit of 50 per cent. In the efficiency when two dynamous were employed in the transmission. of power, neither the error, nor us correction, were of that obvious character in 1879 that one might imagine from reading Mr Murphy's letter,—W. E. A.]

Rain-making

In 1883 I published in Narvara (rol. xavisi., p. 83) an account of some experiments which I made to explain the account of some experiments which I made to explain the curious phenomenous commonly seen at the Bocco of the Solitatra and the action of the flams, even when it direction has been and the action of the flams, even when it direction has been very brief, is observed for some time after in the relatively great increase of cloudy support that appears to roll out of the Bocco and to rate from the surrounding insort unarroles. According you want to the contract of the contract of the second through the second to the contract of the second to the sec cloud or mist) the increase of solid corpuscies made to float in

the vapour-laden air inside or near the fumarole, might be the cause of a rapid and continuous condensing of the invisible vapour. I noticed that the "powdering" of the air with any kind of dust increased the cloudy column issuing from the Bocca of the Solfatara. I am therefore led to believe that the Bocca of the Somman, I am therefore led to beneve that the action of a paper- or faggot-flame in causing the increase of visible vapour from the Bocca of the Solfatara is due both to the production of carbon dioxide and to the increase of solid particles of soot and of light unburnt figurents made to rise and float in the our

These experiments may help in explaining the action of ex-plosives in causing a downfall of rain. Not only does the explosion produce a certain amount of carbon dioxide, but dust is widely scattered in the air, and carried upwards by the hot is widely scattered in the air, and carried upwards by the hot gases produced in the explosion I fit he issuits of the experi-ments in Texas and Kanasa by General Dyrenfurth and Prof Curtus be confirmed, it would be interesting to see if the con-densation of vapour in the atmosphere could be better insured. census on trapour in the almosphere could be better hunch by purposely linerasing the quantity of dust produced in cache explosion. The effect would perhaps be enhanced if the dust were of a markedly hygoresopical nature the cattering in high air of very immune particles of calcium chloride should belig in the making of cloud and rana LAD GIGLIOL. Laboratory of Agricultural Chemistry,
Royal Africultural Chiege, Portici, near Naples,

October 12

Weather Cycles and Severe Winters

THE following view of the relations of severe winters is one

THE following view of the relations of evere winters is on-which I do not received to the seen stated. When I do not receive the three seen stated with the condition of the con

coldest of those preceding, 1870, then come (similarly) 1864

and 1860 Thus we have a succession of severe winters of decreasing severity, and another, after it, of glowing severity.

We may tab	ulate the data		
Severe wenters with lessening severity	Mean temperature	Severe wirters with growing severity	Me in temper tiure
1813	319	186o	37 4

with lessening severity	Mean temperature	with growing	Me in temper nure
1813	319	1860	37 4
1829 1840	33 2 33 9	1864	37 I
1844	. 349	1870	36 4
1846 1854	34 9 1 35 6	1878	34 6
1859	37 4	, 1890	34 I

These data, put into the form of a graphic diagram, give Indee data, put into the form of a graphic diagram, give a wave whose crest (mildest of the severe mitters) we seem to have passed in the svites. And it would appear judging by the past, that we have not yet reached the bottom of the hollow, but that after some years' interval we may have a winter even more severe than last, possibly we may have more than one, of growing severity.

growing severity, I is right to state that, as far as 1856, the values of mean temperature used are those of Mr. Belleville, reduced to sea-level, as given in a paper by Mr. Eaton to the Koyal Meteorologocal Society (Quarterly Journal, January 1888), after that date, those of Greenwich Observatory, published annually. The alight difference in kind does not materially affect the result. In the Materializate Eatherful for September, M Woekof

In the Meleoroughton collectiff to September, M. Woekol considers the question whether winters in Russia have been growing warmer, and his examination of the St. Petersburg records, from 1744 to 1890 (noting the number of cold days), leads to an affirmative answer The number of very cold days). has, on the whole, fallen off considerably in the later sixty-three

years compared with the earlier, and in the second half of our entury, as compared with the eighteenth and the earlier half of the pineteenth

of the ameteenth
This, be finds, corresponds with popular opinion for Northern
and Central Russia, according to which intense frosts have become
more rare, but in the south, in the Chimea, the Caucasis, and
Turkestan, there have been compliants of colder winters of late Mr Glaisher some time ago expressed the view that our winters

to the effect that the proximity of Greenwich to such a rapidly growing only as London might have to do with such a rapidly growing only as London might have to do with such a result. If growing city as London might have to do with such a result. If the facts are as I have suggested above, a growing severity has taken the place of growing mildness, and the criticism referred to would fail to apply.

A B M

A Lunar Rainbow

On the evening of Saturday, October 17, at about 6 30 p m . the rare and interesting phenomenon of a lunar rambow was observed from Patterdale, Westmoreland. On the south-east, the moon, which had just usen, bughtened the sky behind the mountains, while on the north west there hung a uniformly dark and unbroken screen of haze or rain cloud, which lightened off somewhat and was more scattered on the extreme west With its highest point lying almost exactly north west, a semi-circle of pale whitish light was projected against this vapoury circle of pale whitah light was projected against this vapoury curtain. The bow as quite complice, but much brighter and shapere on its northern are than on that falling south. The force of the part () KEEGAN

Patterdale, Westmoreland, October 17.

The Destruction of Mosquitoes

THE recent mention of this subject in your pages reminds me that I was told a few years ago by in English gentleman who has a most beautiful place on the Riviera that he had freed his property from this pest

The property in question is a peninsula, and for that reason is exceptionally open to separate treatment. On the Riviera, as many of your readers will know, fresh water is a somewhat lare commodity, and all of it that the inhabitants can lay hold of is stored for future use in tanks or small receptacles

The larva of the mosquito lives, as I understand, only in fresh water Consequently, on the Riviera he is found in the tanks I have named

The carp is, I am told, passionately fond of the larva of the misquito, and the Englishman I refer to had extirpated the insect by putting a pair of the fish in every tank

The plan is not one that could be adopted everywhere, but it is worth bringing under the notice of those whose circumstances are like those of the Riviera.

Law of Tensions

Possibly many science teachers find some little difficulty in POSSIBLY many science teachers had some little discully in satisfactorily demonstrating to a class the "law of tensions" for wheating strings in practice, unless the sonometer is fixed vertically, the error introduced by friction at the pulley (especially with heavy weights) is so great that the real tension is very different from that represented by the weight attached. Even if the apparatus be him fixed, the changing of the weights occupies time, and a comparison wire is necessary, which must first be luned to exact unison The following a mirable and very simple method was suggested to me by one of my students, and possibly there are some teachers to whom the idea is new

Instead of applying ten ion by attaching weights, the result may be effected much more readily by means of an ordinary spring suspension-balance, such as is often used for weighing

parcels. By this method the tension may be regulated to within half a pound, and increased or decreased so rapidly that the heightening of pitch is clearly recognized without the use of an auxiliary wire

If G WILLIAMS

Congregational School, Caterhan

The Koh I-Nur a Renly

Ir is a far from plea-ant task for me to set about replying to Prof Maskelyne's criticism of my history of the Koh -Nur. I desire to say what must be said with all respect for him, but the tone of some of his remarks renders this a task of exceeding tone of some of his remarks renders this a task of exceeding difficulty. All I care about is to get at the fruth, and in order to do so I have spared neither time nor labour. I cannot suppose that you would grant me space sufficient for answering in detail all the statements in Prof. Maskelyne's article, nor do I seek for such space, because I deem it to be sufficient for those, several of them experts, who have accorded my views their hearty support and approval - Firstly, to state her, in a general way that having very carefully studied Prof Maskelyne's long article it has not, in my opinion, in the very smallest degree shaken the facts I have quoted, and the deductions from them which are to be found in my appendix to "Tavernier's Travels," and in the article pub-lished in the April number of the English Illustrated Magazine lished in the April number of the Linguist Illustrated Alloquestics of the pre-ent year. Indeed, I might go further, and say that this attack very materially confirms the strength of the position upon which I have taken my stand. Secondly, I shall select a few points only which afford clear issues without any mystification, as to which said the balance of evidence hes upon, and mivite readers to draw their own conclusions

Before going further I think I should recall to notice the review of my edition of "Tavernier" which appeared in NATURE last Febinary (vol xim p 313), and the Linglish Illustrated Magazine for April, from which it will be seen that a nggestion made in the review has since been acted upon, with the result that was anticipated

Prof. Maskelyne states that there is an absence of novelty in my facts Just so, it is the old facts that I rely upon, not the miswithings. In my earliest allusions to this subject, many years ago, I made some mistakes, from blindly following authorities whom I now know to have been misted as to their facts. Since then I have learnt how necessary it is to check all statements as of fact in reference to this subject, and not to place too implicit a trust on quotations, no matter how eminent the authority who makes them may be

nixes them may be to the judicial position which Prof. 18 to Compare to occupy, to say hal. I damin Prof. 11 II. Wilson, and what he narraies, "by the somewhat dippont remark that "thas afforded undry imaginary that what has afforded undry imaginary in the lacts being these—I never referred to Prof. 11 II. Wilson; I did not even know before that he was the writer of the anonymous note in the efficial extalogue, and more than that.

I had not that particular contribution to the subject in my mind when writing the above words

Still further, with regard to the judicial position. I do not think it is apparent in any of Prof. Maskelyne's subsequent remarks They are those of an advocate who smites his opponent in season and out of season, and seeks to disparage him by implying that he has as suited the reputation of men (whom all must honour), when he has merely pointed out misquotations in their writings and expressed dissent with their conclusions

writings and expressed dissent with their conclusions.

I yield to no one in my admiration for the late Mr. King's work, but this cannot and should not restrain me from pointing out misquotations and misprints in his books when treating of the subjects with which he has dealt. To justify this I shall quote but a few instances which I have noticed, out of many, On pp 78 and 82 ("Natural History of Precious Stones," Bohn's edition, 1870) the weight of the Mogul's diamond is stated as

contion, 1570) inc weight of the Mogur's diamond is stated as on Tavernier's authority to have been 250 carats and on the plate 268 carats, instead of 379% carats. The Koh-Nur is stated on p 82 to have weighed 184 carats instead of 186 ts, and, strangest of all, when recut, that is to say in its present condition, its weight is given, pp 75 and 347, as 1024 and on the plate as 1021 carats, whereas its true weight is 106, carats

On p 68 he deduces an argument from the note by Clusius, which is referred to by Prof Maskelyne, and given in the original in my paper, the whole force of his argument depending, h

ever, on the change of the word Belgium of the original to Europe in his, Mr. King's, own rendering of it I might add to this list, but sufficient has been stated to show

that such statements require the most careful scrutiny, by whom-

diamond with the Koh-i Nur

that such statements require the most careful scrutiny, by whom-sover they may have been made

On pp 81-82 will be found Mr King's dissent from Prof Maskelyne's theory about the identity of Babar's diamond with the Mogul's, the difference of opinion between them being very wide indeed, though Prof. Maskelyne does not think it

necessary to refer to it in his article With reference to what Prof. Maskelyne writes about De Boot and Garcia de Orta, I shall only say that I am very well ac quainted with both authors' works, and that I assert again that the statement wrongly attributed to Monardes, and quoted as from Mr King by Prof Maskelyne, was an unsound and dangerous link in the chain by which it was proposed to connect Babar's

diamond with the Kohr Nur
It was a statement convenient to use, but what if I had used
it flist, and had also mispinced the authority? Would the terms
and had also mispinced the authority? Would the terms
whatever on my part, and Prof Mak-letyne has himself now
whatever on my part, and Prof Mak-letyne has himself now
whatever on my part, and Prof Mak-letyne has himself now
had the considered the profit of the profit of

exxiv , 18:6, p 247) I still venture to think that my conclusion as to the kind of I still venture to think that my conclusion as to the kind of carat used by Taveriner is a legitimate one. At the end of chapter xviii, book ii, he says, where computing from their weights the values of diamonds to a farri, "le Diamant du Grand Mogol pese 279% carati" (4a), and in the very next paragraph, "le Diamant du Giand Duc de Toccane pese 1394 paragraph,

I rue it is, as pointed out by Prof Maskelyne, that Tavernier in some other passages defines the carats as "nos carats", he does not say, however, "carats de Fiance," and the meaning does not say, however, "carats de Fiance," and the meaning therefore I take to be the carats employed by himself and his confracterinty as contracted with Indian measures of weight. The value of the abbas or peath out; of 2 66 grains, or seveneighths of the Florentine carat, has also been approximately

engines of the reference caret, nas also been approximately arrived at hy other relations given by Tavimer, conveisely, therefore, it proves his carat to have been the Florentine.

I know of several carly writers who have writen about the Grand Duke's diamond, and by them Favernier is referred to as Grand Duke's damond, and by them l'averner v referred to a the authority for its weight, which, as even Prof Maskelyne admits, was given in Florentine caratt. I think all the cir-cumstances justify the belief that it was probably weighted. If Toveniner himself with his own weights and sealer. Now level Frod Maskelyne (p. 557) Mates that l'averneric does not say be weighed any of the siones, and, in another, on the same page, "The damond l'averner saw, weighed, he said lwas he merely he diamond Tavernier saw, weighed, he said (was he merely

aniamona i awerner saw, weighed, he said [was he merely told so or did he really weight it?], 3194 ratis "
The pages of Taverner give the following very explicit answer to this query. He says, "Ce diamant appartient au Grind Mogol, lequel me fit Ihonneur de me le faire moniter avec Mogol, lequel me hi l'honneur de me le laire montrer avec cous ses autres joyaux. On vot la lorome ou il est demeuré ciant taille, d'm'ayant esté permis de le feis jay ironée qu'il fest 3164 stats qui soul 2797é, de nos carat.

This is precise evidence enough that he did weigh the stone himself, and if the caratis were 1 rench instead of the lighter

Florentine carats, which I believe them to have been, the stone was so much the heavier, and therefore still more removed in weight from Babar's stone

Tavernier, I must remind the reader, besides Beruier, is our only authority for what is known about the Mogul's stone, as such, and what I have protested against and still protest against is, the suppression or rejection of such precise statements as the

In various directions I have been enabled to show Tavernier's minute accuracy about matters not connected with his trade as a jeweller, and when he speaks as an expert, in the practice of his own profession, he deserves, and proves that he deserves, a very different treatment from that which he has received. It is for this reason, and not because I am blind to his faults, that I give him my loyal support I have already, in vol. ii. of "Tavernier's Travels," stated that some corrections of values given in vol. are required in consequence of the identification, made too late for their correction, of the value of Tavernier's creat, but the present discussion as to the Koh i Nur is quite independent of that.

With regard to the mutilated condition of the Koh-i-Nur, I

write regista to the matinatea condition of the Roh-t-Ruit, I have nothing to add, the statement as toliv condition, quoted by me, and the figures and models of the stone appear to be sufficient proof that portions had been removed by cleavage, which would account for the difference between its weight and the Mogul, as described by Tavernier, and I still retain that

opinion It is not of the least importance as regards the main question. whether my suggestion should prove correct or not, that if Bahar's stone has survived it may be identical with the Darya i Nur, to which Maleolm attributed a weight of 186 carats Prof Maskelyne, upon a system of calculation which I cannot admit as applicable to the case, as we do not know the thicknesses of the stones which he compares, gives to the Darya: Nur an estimated weight of 210 carats For the present, therefore, I prefer Malcolm's definite statement to Prof Maskelyne's theory about the attributed weight being the "echo associated with the Koh-

I shall have something to say about the Golconda table diamond, and about a great many other diamonds and other precious
stones too, on a future occasion In that work I shall be as careful sones 100, on a twine occasion. In that work I shall be as careful to give, as I have hitherto been, chapter and verse for every statement of fact quoted, and I shall must the histories so apported will find acceptance from those who care to in vestigate the evidence in favour of the conclusions connected therewith

Tam not quite sure that I appreciate the full force of the phrase "versimilitude of a true history"—the last works of Prof. Maski-june'a article—but of thir I am ceriain, that if ever I should see a history of the Koh i Nur following the these of that article, I shall feel bound to make another and special "incursions" into

Dublin, October 12 U BALT.

THE NAULICAL ALMANAC.

T has been known for some little time that Di John Russell Hind, F R S, who for many years past has been responsible for the production of the national ephemeris, would soon seek that retirement to which his long services and his distinguished career entitle him. At the end of the year, he will relinquish the office of Superintendent of the "Nautical Alamanac," and the good wishes and kindly sympathy of the astronomers of many nations will follow him in the retirement he is seeking

His successor has been appointed, and in Mr A M W. Downing we have not the slightest doubt that the Admiralty have made a happy selection, and that under his auspices the high character and reputation of the "Nautical Almanac" will be fully maintained Mr Downing has long been associated with meridian astronomy in its best traditions, and in his position of greater responsibility and greater freedom we entertain the hope that his astronomical reputation will be fully maintained and extended He may be said to enter on his office at a time when the "Nautical Almanac" is on its trial The arrangement of the book, and the information it conveys, were practically settled by a Committee some sixty years since How efficiently that Committee performed years since How emclently that committee performed its task is shown by the fact that so little alteration has been needed for so long a period. But the outcry for change has gone forth—new committees are deliberating and reporting, and it will be among Mr. Downing's first duties to give shape, alike to the suggestions of irresponsible authorities, as well as to incorporate the recommendations of recognized committees in a new and improved "Nautical Almanac."

One great difficulty which has to be encountered, and of which it is not easy to see the proper solution, is due

NO. 1147, VOL. 44

to the fact that the "Nautical Almanac" seeks to supply the wants of two very different classes of persons-namely, astronomers properly so called, and nautical men. The former demand very considerable detail in the exhibition of the several computations, the latter are satisfied with a very few final results. The former class is a small one, and a very moderate edition would satisfy their demands. The latter class is a very large one, and necessitates the printing, it may be, of thirty or forty thousand copies The first question therefore, it seems, which must claim the attention of any Committee, or of any Superintendent, is, whether it be desirable to sepa-rate the "Nautical Almanac' into two, or it may be more, sections-one circulating among astronomers, the other among mariners Private enterprise, anxions to minister to the wants of a rapidly increasing mercantile marine, has and pirated edition, valuable to sailors, but detrimental to the circulation of what may be considered the legitimate ephemeris Wouldit not be better if the Admiralty could see their way to publish an ephemens with other nautical information, entirely for the use of the marine? Such a course is followed by the Governments of other countries. The German Government publish at Berlin a compact
"Nautisches Jahrbuch," admirably adapted for naval
purposes This example is followed in Austria and in America, and we believe that the sale of our "Almanac" to the naval men of those countries has fallen oif in the last years, or at least has not kept pace with the increase of foreign tonnage

Such questions are of importance, as concerning not only the financial position of the work, but its influence There are, however, others touching the scientific and purely astronomical side of the compilation Such, for instance, is the vered question of the introduction of empirical terms in the final positions of the moon. Astronomical purists will maintain that the position of the moon should be that assigned by a purely gravitational theory, to facilitate the comparison of that theory with observation. Others demand that the place of the moon should coincide as accurately as possible, with observation, and looking at the large portion of the "Nautical Almanac" devoted to "lunar distances," it would seem (if this section is ever used) that it is desirable that the distances given should represent observed facts After a naval man has been at the trouble of observing and reducing a lunar distance, to ask him to apply a correction for the error of moon's place seems wanton and irritating And if the amount of the empirical correction is clearly ascertainable, it can be easily removed before instituting a comparison between observation and that theory from which the moon's place has been computed. But to satisfy the demands of both classes of astronomers will try the tact and ability of the new Superintendent to the utmost

The section devoted to the apparent places of the stars has also been submitted to considerable criticism. No doubt here enlargement is needed, and possibly im-proved places of the stars, particularly of circumpolar stars in the southern hemisphere, are much wanted But on this point the new Superintendent is himself a weighty authority. He has worked much and successfully in the determination and removal of systematic differences from star catalogues, and their reduction to known and recognized standards. So that, under his influence, we may hope that this section will take and maintain a foremost position

Mr. Downing has undertaken a very important duty, of great national importance, at a very critical period. We fully believe that he will grapple with this task successfully, and that, in his efforts to improve our ephemeris, he will have the assistance and support of all classes of astronomers

recommendation of the orbitalmic section of the British recommendation or me opininaling sectors of that all candidates for masters' or maters' certificates shall pass a test examination as to their ability to distinguish the a test examination as to their ability to distinguish the following colours, which enter largely into combination of signals by day or night used at sea; viz. black, white, red, green, yellow, and blue"; and they state that "the Board have been led to this decision because of the serious consequences which might arise from an officer of any vessel being unable to distinguish the colour of the lights and flags which are carried by vessels."

So far so good. But there the matter stopped officer failing to pass in colours is not deterred from going to sea : his certificate is simply endorsed " failed to pass in colours," and then it is optional with the owners, if they know of a man's colour imperfectness, to engage him or not In the majority of cases they do not know Wishing to obtain accurate information as to the views of the Liverpool shipowners upon this subject, I submitted to

them the following queries -

(1) Do you consider a colour-blind officer, mate, or captain, competent to have command of a vessel, steam or sailing?

(2) Would you consider a colour-blind man fit to be a look-out man?

In reply, 110 firms answered both questions in the negative, while one answered both in the affirmative Six said "Yes," to the first query, and "No," to the second

Six expressed the opinion that no colour-blind officer should have command of a vessel; but that colouiblindness was not a barrier to a seaman officiating as look-out

The language of the firms that answered both questions in the negative was such as to show that there was not the slightest hesitancy in the minds of the writers as to the utter undesirability, not to say danger, of employing a colour-blind man in any capacity in which he was responsible, in part or whole, for the safe navigation of the vessel

Such expressions as "emphatically no," "absolutely unfit," "not fit to serve on a ship," "very unsuitable," &c , show in unmistakable terms the views held by Liverpool

shipowners on the subject

Liverpool shipowners certainly seem alive to the dangers of colour-blind employer vate examination would seem to be coming into common practice among first class firms But the Board of Trade have still to realize that look out men, as well as officers, should not suffer from colour-blindness If shipowners themselves deem it necessary for their own interests, and the safety of the noyageurs and property intrusted to their care, to debar colour-blind seamen from their service, it is surely incumbent upon the Board of Trade, in the interests of the travelling community over whose welfare they are supposed to preside, to make perfect colour-vision a causa sine qua non that shall apply to all seamen of our mercantile marine It is but fair, however, to that complex and overburdened instrument of government to add that they have introduced a so-called voluntary test, whereby a seaman, on payment of a fee of 1s, may be tested as to the perfectness of his vision for colour Such a test must, from the very necessities of the case, be absolutely worthless What AB would be likely, had he the slightest suspicion of his colour-blindness, to seek that confirmatory evidence which would debar him from following his calling? Sailors may be person from from onewing his calling? Sailors may be pardoned if they prefer to remain in a state of blissful ignorance as to their colour vision, since they have nothing to gain, and possibly everything to lose, by undergoing an examination in colours. It must be admitted, however, that there are not wanting those who aver most positively that colour-blindness is not responsible for maritime disaster of any description whatever

Rear-Admiral P. H. Colomb is of this opinion. In discussing the action of the Washington International Maritime Conference relative to colour-blindness, he stated, "I never knew myself a case of collision where colour-blindness was in question. The statements were generally perfectly clear that wrong helm was given deliberately in the face of the colour seen, and as no authoritative teaching had existed to show that it mattered what colour was seen as long as danger was denoted, I have never been able to lay stress on the colour-blind question"

Again, Admiral Colomb expressed the opinion "that collisions at night occurred through the helm being ported to the green light, and starboarded to the red light"

Undoubtedly this is a fertile source of disaster, but seamen, unless we assume them wilfully negligent, or astoundingly nervous, could hardly fail to act correctly at the critical moment in so many instances, if there were not some other factor at work which brought them to grief I admit the truth of Admiral Colomb's statement as to collisions at night occurring through the helm being ported to the green light, and starboarded to the red But I would go further, and inquire why such a wrongful procedure should be adopted in so many cases I cannot believe it is done wilfully with the intent of causing collision, I cannot accept nervousness on the part of men, many of whom have spent a lifetime at sea, as the sole, or even a likely cause I believe that in many cases the reason why the helm is ported to the green light and starboarded to the red light is that the persons responsible for the porting and starboarding are visually incapable of differentiating between one colour and the other

Admiral Colomb's cause is undoubtedly the immediate means of effecting the collision, but that cause traced to its original source will, in the majority of cases, show neither negligence nor nervousness, but will stand revealed as the inevitable resultant of evesight that cannot distinguish red from green. Pronouncements such as those quoted above, coming from those in high places, and pregnant with the weight of authority that usually attaches to such utterances, are mainly responsible for the general layity and half-heartedness which are so characteristic of the Board of Trade's officials in respect to colour-blindness A perusal of the records of inquiries into collisions at sea, or of the courts which settle questions of maritime and commercial law arising therefrom, reveals an assounding amount of conflictory evidence as to the relative positions of the colliding vessels as judged by their side-lights. It would be more charitable to suppose that the witnesses examined were colour blind, rather than guilty of wilful and deliberate perjury In such cases the question of a look-out's colour percipience is never discussed. An examination of the witness on the spot, as to his capability of discriminating between the port and starboard lights of a ship, would set at rest the question of his physical competence to assist in elucidating the problems under considera-

The Dutch Government has long been alive to the dangers accruing from induced colour-blindness-I use the term induced in contradistinction to congenital-and adopt the most drastic measures to prevent a colourblind officer from holding a position in their mercantile marine. Among other qualifications necessary to procure a warrant empowering a man to act as mate in the merchant marine, the royal order requires —

"Colour perception perfect for transmitted light in one eye, and at least one half in the other, according to Donders's method "

Also that " the report and declaration of the expert, as required in the above, shall be considered valid for one month only from the time the test is made."

In Holland the tests are made by experts In England they are applied by persons who, however well they may be qualified to examine candidates in navigation and seamanship, have certainly no locus stands in the matter of reporting upon the perfectness, or otherwise, of

a man's visual organs.

The tests themselves that these navigation examiners The tests themselves that these navigation examiners have to apply are far from being perfect. They are established upon a wrong principle. Candidates are made to name colours, and according to the Parlamentary Report of 1887, "the only reasons for which they are reported as having failed are mability to distinguish red from green, and either, from black by daylight, and red from green and either from ground glass by artificial light,

Candidates are first required to give correct colour names to a series of eight cards coloured black, red, green, pink, drab, blue, white, and yellow, respectively A candidate is passed, however, if he names correctly

the first three

The second test consists in naming the colours of glasses some eleven in number, viz ground glass, standard red, pink, three shades of green, yellow, neutral tint, two shades of blue, and white The candidate need, howtwo shades of blue, and white ever, only name the ground glass, the standard red, and the standard green

Clearly, with such tests as these, the colour-blind may

easily escape detection. The Board of Trade return relative to colour tests for the year ending May 31, 1891, shows that out of 4688 can-didates who presented themselves for masters' and mates' certificates, 31 were rejected on account of deficient That these should be rejected after serving colour sense. colour sense. I not these should be rejected after setting an apprenticeship to the sea, is manifestly unfair. The test should be applied at the commencement of their rest should be applied at the confinemental of their natural career, and not when the initial stage is passed. Four of the 31 were reported as passing on subsequently undergoing examination, although medical expert opinion is emphatic in stating that colour-blind-ness is absolutely justime 46. Perhaps it may be that the examiners were disposed, by their leniency in passing young men whose previous "failure in colours" proved young men whose previous "failure in colours" proved them colour-blind, to atone in some slight form for the bad system which allows lads to spend the best years of their life in mastering the irksome details of a profession. before it informs them that they are visually unfitted for It is to be hoped that the investigation into the whole system of colour-testing at present being conducted by a committee appointed by the Royal Society, may lead to thorough and effective reforms T H BICKERTON

ON VAN DER WAALS'S IREATMENT OF LAPLACE'S PRESSURE IN THE VIRIAL EQUATION A LETTER TO PROF TAIT

MY DEAR PROF. TAIT,-I gather from your letter VI of September 28 (NAIURE, October 8, p. 546) that you admit the correctness of Van der Waals's deduction from the virial equation (i) when the particles are infinitely small, in which case

$$\left(p + \frac{a}{v^2}\right) v = \frac{1}{3} 2m V^2 \quad . \tag{1}$$

a representing a cohesive force, whose range is great in comparison with molecular distances; and (2) when, in the absence of a cohesive force, the volume of the particles is small in comparison with the total volume v_i , in which case the virial of the repulsive forces at impact gives

$$p(v - \delta) = \frac{1}{3} \Sigma m V^2 \qquad . \qquad . \qquad (2)$$

For hard spherical masses, the value of b is four timethe total volume of the sphere. But you ask, " How can

the actor (v - b)/v, which Van der Waals introduces on the eft (in the first case) in consequence of the finite the entire that it is the limit case, in consequence of the limit diffin eters of the particles, be justifiably applied to the term in K (or a/ν^2) as well as to that in ρ ?

In my first letter I desired to avoid the complication entailed by the consideration of the finite size of the particles, but it appears to me that the argument there given (after Van der Waals) suffices to answer your question For, if the cohesive force be of the character supposed, it exercises no influence upon any particle in the interior, and is completely accounted for by the addi-In so far, therefore, as (2) is correct tion to p of a/v" when there is no cohesive force, the effect of such is properly represented by

$$\left(p + \frac{a}{v^2}\right)(v - b) = \frac{1}{2}2mV^2$$
 (3)

in which δ is to be multiplied by a/v^2 , as well as by δ . Yours very truly.

Cutober 13 RAYLEIGH

NOTES

At the Royal College of Physicians, on Monday, when the Harveian Oration was delivered by Dr W II Dickinson, the Baly Medal was given to Prof Michael Foster for distinction in physiology, the Morgan Medal to Sir Alfred Garrod for distinetion in clinical medicine.

DR DICKINSON, in the Harveian Oration, presented an admirably clear and vigorous account of liarvey's great discovery, and of the scientific results to which it has led The earliest and most important of these results was the completion of Harvey's work by the discovery of the capillary system by Malpiglii, who was born in the year in which Harvey published his famous treatise "Harvey," said Dr. Dickinson, "had never seen a capillary, nor did the state of the microscope in his time allow of it. He was fain to conclude that the blood passed from the arteries to the veins partly by anastomoses but mainly by percolation, as water, to quote his own illustration, percolates the earth and produces springs and tivulets. Had it been possible, we may imagine the delight with which he would have witnessed the completion by vessels of his circular route" Dr Dickinson also referred, among other results of Harvey's discovery, to embolism, and to our knowledge of inflammation, or at least as much of it as concerns the capillaries. In conclusion, he said -"Knowledge has been advancing since Harvey's time in many and independent lines, the achievements of Bell, Bright, and Addison had no direct connection with his, but it is not too much to assert that the medicine of to day is scarcely less permeated with the results of Harvey's discovery than is the human body with the circulation he discovered. It does not make him small to say that what he found out must have come to light had he never lived If Columbus had not discovered America some one else must have done so before now. The law of gravity might even have been revealed in the fulness of time to another if not to Newton But the discoverer is before his time, in this lies one measure of his praise, another, and a more important one, is in the results of his discovery."

THE Electrical Exhibition, to be opened at the Crystal Palace on January 1 next, promises to be one of great interest and importance The requests for space-which already exceed a total of 200-include electric lighting plants for country and towa houses, for mines, for steamships, for railway trains, and eyen for private carriages. There are also included the newest forms of motors, generators, accumulators, and other machinery employed for producing and storing electricity. Several of the more important exhibits at the Frankfort Exhibition will be transferred to the Crystal Palace. The apparatus section will include a complete set of Sir William Thomson's stanlard electric instruments, new electro-medical and electro-thermon apparatus, the latest improvements in telephony and telegraphy, and also the most recent electrical appliances for war purposes, blasting, signalling, &c Special buildings are n.w in course of execution for bollers and other heavy machinerr.

THE Municipality of Genoa has voted the sum of 15,000 lire in aid of the International Botanical Congress which is to be held in that city in September 1892 to celebrate the fourth centenary of the discovery of America.

THE French Association for the Advancement of Science will meet at Pesançon in 1893

THE Russian Geographical Socie'y has awarded its great Constautine Medal to Prof Sludsky for his researches into the figure of the earth and his geodetical work generally. Another Constantine Medal has been given to Prof Pontebnya for his researches into the ethnography and the languages of the Great Russians, the Little Russians, and other Slavonians. Ilis two works on the Russian grammar far surpass all previous works of the kind, not only in the number of examples but in the novelty and importance of his conclusions as to the structure of the Russian and other Slavonian languages, while his works on Great and Little Russian folk lore are full of new and profound observations The Count Lutke's medal has been awarded to 5 D Rylke for an elaborate work on the determinations of longitudes in Russia by means of the telegraph, the probable error of the chief determinations does not exceed 0.016 of a second of time Another work of the same geodesist deals with the possible errors of levellings, as dependent upon temperature , they appear considerably to exceed these admitted in the best We also learn from Mr Rylke's retreatises on this subject searches that the level of the Baltic Sea, as deduced from long series of observations, regularly sinks in the direction from porth to south. Other gold medals have been awarded to Rovinsky, for a work on the geography and history of Montenegro , to M Filipoff, for researches into the changes of the level of the Caspian Sea, to M. Obrutcheff, for a geological and orographical sketch of the Transca-pian region, and to M Priklonsky, for a work on the Yakutes Some silver medals have been awarded for works, chiefly in ethnography, of minor importance

DR A R FORSYIII, FRS, and Dr. M. J. M. Hill have been nominated to fill up the vacancies caused by the retirement of Dr. Hirst, FRS, and Mr. Lachlan from the Council of the London Mathematical Society

MR JOSEPH THOMSON has returned to England from South Africa, where he has been at work on behalf of the British South Africa Company Accompanied by Mr Grant, a son of Colonel Grant, he crossed the plateau between Lake Nyassa and Lake Bangweolo, and we learn from the Times that he has been able to make suportant rectifications in the geography of the Bangweolo region. The lake, as shown in our maps, is incorrectly laid down, mainly because the one definite and precise observation taken by Livingstone has not been adhered The lake is really only a backwater of the Chambeze (the source of the Congo), which enters from the east, and issues from the west of the lake as the Luapula | The lake, in fact, hes in a very slight depression of the plateau to the north of the Chambeze Luapula Even in the rainy season Mr. Thomson believes the lake does not exceed 20 fect at its deepest. The southern shores are clothed with forests, and, as a matter of fact, Mr Thomson encamped far within the bed of the lake as it is laid down in most maps. In the rainy season the water of the lake spreads out, and covers for some distance the ground on which the forest stands.

NO. 1147, VOL. 44]

MR. W L SCLATER, the IDenuty Superintendent of the Indian Museum, Calcutta, will proceed to Upper Assam in December next, upon a collecting expedition for the benefit of the Museum From Makum he will ascend the Dibing river in boats to the mouth of the Dapha, one of its confluents from the north, and establish his camp at some convenient spot in the Dapha valley At the head of the Dapha valley rises Dapha Bum, a mountain of some 15 000 feet in altitude, on the frontiers of Chinese territory, so that there is a good prospect of the occurrence of Chinese for as in the district. The Dapha valley has been described geographically by Mr S E. Peal. who visited it in 1882 (see J A S B, lit, pt 2, p 7), but has not been much explored zoologically Mr Sclater will pay special attention to mammals and birds.

MR FRANK II BIGFLOW, who has been acting as assistant in the U S Nautual Office, has been appointed to a newly-created professorship in the American Weather Bureau. His work will relate to terrestrial magnetism and solar physics, especially in their relation to meteorology

Niws has been received of M. Paul Maury, who started in March last year fo a botanical expedition in Mexico, and of whom nothing had been heard since his departure. He appears to have made a successful exploration of the province of Huastera.

DR 5 WINGGRADSKY, of Zurich, has been appointed director of the scientific bacteriological section of the new Bacteriological Institute at St. Petersburg

A NOTICE which will be read with interest by owners of gems has been issued by Dr A Brezina, the Director of the Mineral Department of the Natural History Museum at Vienna. relates to the doings of a young man who, on September 26, contrived to conceal himself in the Department just before the time for the c'osing of the Museum He was caught, and found to be arme I with a revolver, and to have in his possession files and other implements. He had also in his possession nearly 600 gems, some of them cut, but the majority in their natural state. He has a passport, in which he is described as Hugo Kahn, of Berlin , but he has also called himself Krony, Kronek. Kornak, Kronicsalsky. His age is twenty four , he measures in height 170 cm , he is slender, has a longish, handsome face, is of a brownish complexion, has dark hair, grey eyes, and a lightbrown beard, which is of feeble growth Upon the whole, he is an attractive-looking person. He has made several journeys in Germany, France, Switzerland, and Italy, and between the middle of July last and the beginning of September he travelled through Pyrmont, Ems, Strasburg, Basel, Milan, Genoa, Nice, Monaco, Genoa, Venice, to Vienna Most of the gems (the names of which, with the exception of a rock crystal, he does not know) he professes to have bought from a barber in Marseilles. As it is important that the former owner or owners should be known, Dr Brezina prints a list of the gems, with the request that anyone who has information about them will communicate with him

ON Monday the centeary of the Royal Veternary College in ferat College Street, Camden Town, was celebrated by a lunchcon given in a tent which had been excited in front of the new buildings. The Duke of Cambridge, Preadent of the College, took the chair, and the Prince of Wales was among the general far proposing the toss, "Success and continued proingers and the control of the control of the control of the important position of the College at the present day with its humble beginnings shunderd versus."

WE regret to record the death of the Rev. Percy W. Myles, of Bright's disease, at the comparatively early age of forty-

wo, at Ealing, on October 7. He was a man of great shilly both in hierary and sclemific pursuits. He was a good botanst, and proved himself a most able editor of Nature Netes, the journal of the Schorne Society The work with which his name will be identified in the "Pronouncing "Dictionary of Schrincal Names," appended to Nicolosova" "Dictionary of Gardening", it is now recognized as a standard work by botanests. Unfortunately his professional standard work by contains. Unfortunately his professional posed to raise a "Myler Memorial Fund" on behalf of his widow; and sny contributions with the thankfully received and at once acknowledged by the Rev Prof G Henslow, Drayton House, Eding, London, W

THE Council of the Institution of Civil Engineers has susted a list of subjects on which it invites communications. The list is to be taken incerly an suggestive, not in any sense as chanavive. For approved papers, the Connecl has the power to award premiums, arrang out of voccil funds bequested for the purpose. A detailed list is given of the awards under for original communications submitted during the UMS statement.

Most than ten esthquake shocks were felt in the island of Patentlains, between Sielly and the Tanisan const, between 5 pay and the Tanisan const, between 5 pay pan and 4 a m on October 14-15. Some of the shocks were rather worken, and nearly all the mabitiants left their houses and pa-sed the night in the street or in the open country and According to intelligence received at the Central Meteorological Bareau, Rome, from Pantellaras on October 18, shocks of earth quake continued to be felt in the shall A requarkable phenomenon is announced in connection with these sewmed disturbances. A new volcann has rane from the held of the sea, not far from the coast of the Island, and has been throwing up masses of stones and rubbath to a considerable height A "slight emption" from it was referred to in a telegram sent from Rome on October 20

LAST winter there were some reports that sunset phenomena had greatly increased in brilliancy, as if something similar to the optical disturbance following the Krakatao eruption had occurred Herr Busch has remarked (Met Zeit) how difficult at is to recognize gradual variations in such phenomena, or to say where they pass beyond the normal. Even the brown-red Bishop's ring may be regarded as quite normal in winter A much more sure method of finding an optical disturbance of the atmosphere is measurement of the polarization of light. Herr Busch has earried this on systematically for some years with a Savart polariscope, and a simple instrument for measuring angles, determining the height of the two neutral points (Babinet's and Arago's) at sunset Now, the values for this height, in February and May last, considerably exceed those obtained in the three previous years, and come near those in 1886, when the last traces of the great atmost henc disturbance were still everywhere perceptible It would seem, then, that some optical disturbance has been really present, the beginning, extent, and cause of which, however, are in obscurity The desirability of systematic observations in different places is pointed out.

IN constance O'Cotober 8 (p. 549) we drew attention to three aliases insued by the Chris Signal Officer of the U.S. Army. We have now to record the publication, dated June 15 last, of an atlas containing seventy-two charts showing the normal temperature conditions in the United States and Canada by decodes, three desented to each month, for 55, are and 80 pray, Wathington words of twenty years, at had not before been able to accumulate attention of twenty years, at had not before been able to accumulate attention of the seventy of the second of the second

t years' observations, 1881-89 The charts have been carefully prepared, for the work of the Forecast Division, and will also be very useful in furnishing general information goon the average temperature of North America. The work has been prepared gunder the supervision of General Greely, although issued by the new Weather Bureau.

THE Enling Muddlesex County Times (October 17) prints the following account of an incident which occurred at "The the residence of Mr Vates Neill, Ealing, on Wednes dav. October 14 -" It appears that during Tuesday night a large branch of one of the magnificent chestnut trees standing in the ground was broken off by the force of the wind, and fell on two stripling chestnut trees near the wall. On Wednesday morning, the gardener, a man named Parker, was engaged in sawing the detached bough, Mr Delancey Neill and Mr Vertic Neill watching the operation first before noon, the first-named gentleman saw what appeared to him to be a ball of fire fall. and striking the tree in an oblique direction, alight on the ground within two or three yards of where the three were standing, whence it rebounded and exploited with a sound like dynamite Although neither of them was struck, the shock was so great that for a time all three were dazed. Mr Vertic Neill, indeed, being thrown down, and rolling over two or three times. His brother was the first to recover from the shock, and promptly went to his help, and he was removed to the house, where the feeling of dizziness spredily wore off, and beyond somewhat severe headaches, which lasted for some hours, neither of the gentlemen nor the gardener appeared to have suffered any ill effects. The trunk of the tree struck by the meteor presents the appearance of having been burned in a zigzag direction for a distance of some 20 or 30 feet

Most people who west Greece devote their attention mainly to the remains of ancient art. Dr. Philippion, of Berlin, is of opimion that they might also with advantage spend so not me in climbing the mountains of Greece. In the Assaurage development, and the abject in a capit alpage, which has been issued separately He gives an attractive account of his own experiences in climbing Mosant Cheleno, in the Peloponnece, describing admirably the impression produced upon him by the Styr. Dr. Philippion districts that the description of the produced property of the description of the described of the description of the des

MESSRS W. H ATTEN AND CO have published a second edition of the late Mr. R. A. Proctor's "Other Suns than Ours."

THE new number of the Internationality. Inchin Jin. Ethios. explain opens with most interesting paper (in Cereman by Dr. I demnarch on "The Islands of the Dead, and related Gap againsted Myth." The author shows how whilely diffused is the belief that there are far-off happy islands, where all vorts of enopyments are in store for the dead, and he suggests that Atlantis, about which so much has been written, was originally one of these inputical realine. Dr. J Jacobs concludes his critical examination (in Datch) of Dr. Plous's view of the significance of circumension.

MR 6 J SYMON, F R S, contributes to the current number of the Quarterly Journal of the Royal Meteorological Society a karned paper on the hastory of rain gauges. It was read before the Society on March 18, in connection with the annual cubbation, and is one of the curren in which hypometation, and is one of the current in which hypometation, and is one of the current which hypometation, and is one of the current which hypometation, and is one of the current current current cubbation, and is one of the current cubbation of the current cubbation of the current cubbation of the current cubbation of the current cubbation. As we have the cubbation of the current cubbation of the current cubbation of the current cubbation.

successively dealt with Among the remaining contents of the number are papers on the following subjects: meteorological photography, by A. W Clayden; on the variations of the rainfall at Cherra Poonice, in the Khasi Hills, Assam (plate). by H F. Blanford, F.R S ; some remarkable features in the winter of 1890-01 (four illustrations), hy F. J Brodie , the rainfall of February 1891, by H. S. Wallis , "South-east Frosts," with special reference to the frost of 1890-91, by the Rev F. W. Stow.

In the latest record of the proceedings of the Philosophical Society, Philadelphia, Dr Daniel G Brinton gives some vocabularies from the Musquito Coast. He obtained them from the Rev. W Siebniger, a missionary of the United Brethren. now resident in that region The most important of the vocabularies is a list of words from the language of the Ramas tribe, the only specimen of their tongue Dr Brinton has ever secured. These people live on a small island in Blomfield Isgoon There are at present about 250 of them All of them have been converted to Christianity, and, with the exception of a few very old persons, are able to speak and read English. Their native language is rapidly disappearing, and in a few years, probably. no one will use it fluently and correctly. They are large and strongly built, and are described as submissive and teachable. Their language has always been regarded as wholly different from that of the Musquito Indians, who occupy the adjacent mainland, and this is shown to be correct by the specimen sent to Dr. Brinton. It bears no relation, he says, to any other tongue along the Musquito Coast It does not, however, stand alone, constituting an independent stock, but is clearly a branch, not very remote, of a family of languages once spoken near Chiriqui lagoon, and thence across-or nearly across-to the Pacific.

THE Penang Administration Report for 1800 contains some interesting observations on the little-known aborigines of the Malay l'eminsula Observations made during the course of the year go to show that the Sakal (as distinguished from the Semang, or Pangan, as the Negrito tribes are called by the Malays of Perak and Pahang respectively) are far more numerous than was formerly supposed, and the President is of opinion that there may be more than 5000 men, women, and children in the district of Ulu Pahang alone The country on both sides of the mountain range, which forms the watershed of the Ielas, Selom, Bidor, and Kamnar rivers, is thickly inhabited by Sakat, who, although one or two large villages exist, live for the most part in groups of from two to three families. These pakar are divided into two distinct tribes, called by thomselves Sen of and Tem-be respectively, the former being the more civilized and more accessible tribe, while the latter are but little known to the Malays. Both the Tem be and Sen-or dislects, however, resemble one another so closely that it would seem to be evident that they originally sprang from the same source Words to express any numerals higher than three are not found in the dialect of either tribe.

THE mareograph in the harbour of Pola, according to Lieut. Gravel (Met. Zeitsch.), often shows, in addition to the ordinary tidal curve, certain more or less regular oscillations, generally with a period of about 15 minutes (some with one of 7 minutes) These appear to be of the nature of sesches, and to be caused by squalls, which drive water from the open sea into the partly inclosed basin of the harbour, where it rises as a wave, retires, rises again to a less height (as only part of the surplus water escapes), and so on. Thus, in the evening of July 6, 1890, after a suff west-north-west squall, there were eight pronounced oscillations, the strongest showing about 1'4 mch difference of level in 16 minutes. In another case, the harbour level rose higher than it had done for 15 years. The latter squall (a strong south-west one) affected also the Trieste mareograph, aqueous solution of azoimide was obtained upon distilling the

which showed nine wide oscillations with a mean period of r hour 46 minutes Lieut, Gratzl suggests observations as to whether sudden impulses of "bora" against the Italian coast might not heap up the water there, so that a return wave might affect the Austrian mareographs; also whether certain sudden currents which mure fishermen's nets in the Dalmatian canals may not be connected with those waves.

A CAT born with only two legs (the fore legs being absent from the shoulder-blades) has been recently described by Prof. Leon of Jassy (Nature. Rundsch) It is healthy, and goes about easily, the body in normal position. When startled, or watching anything, it raises uself to the attitude of a kangaroo. using the tail as a support. This animal has twice borne kittens; in both cases two, one of which had four feet, the other only two

WE learn from Dr Woeikof's notes of a journey in the Caucasus published in the Russian Javestia, that the Russian Ministry of Ways and Communications has issued a very interesting work on the snow-slips of the Kazbek glaciers, accompenied law an etlas of mans and plans Careful measurements of the variations in the position of the lowest end of the Devdorak glacier since 1878 have been made, and the results are given in the atlas A house has been recently built close to the clacier, and it is connected by a road (available for horses) with the villages beneath An experienced guide, who is bound to accompany the men of science and tourists who may intend to visit the glacier, stays in the house.

A KIND of artificial honey which has lately been produced seems likely to become a formidable rival of natural honey It is called "sugar honey," and consists of water, sugar, a small proportion of mineral salts, and a free acid, and the taste and smell resemble those of the genuine article Herr T. Weigle brought the subject before a recent meeting of the Bayarian Association of the Representatives of Applied Chemistry, and there is a paragraph about it in the current number of the Board of Trade Journal

RATS at Aden appear to have a vigorous appetite, and to adopt remarkable ways of gratifying it. Captain R Light, writing on the subject from Aden to the Journal of the Bombay Natural History Society, says the rats in his house-which is overrun with them-demoli-h skins, braces, whips, &c , and one night he awoke, feeling a rat gnawing at his toes. This happened in spite of a dog (a good ratter) being in the room. Captain Light was lately watching his pony being shod, and noticed the hoof apparently cut away all round the coronet, wherever it was soft. He accused the "nalband" of doing this in addition to the usual rasping of the hoof to suit the shoe. The "syce" said that the rats had done it, and that they came at night and ate away not only the pony's hoofs but those of the goat and kid, and that these animals were greatly tormented by the rats Captain Light examined the hoofs, and found be; and doubt that such was the case, the marks of the teeth being plain , moreover, he found that the horns of the kid, which had been about half an inch high, were eaten flush with the head Next morning, too, a large rat was discovered in the bedding under the horse. It had evidently been killed by a kick from hım

Two new methods of preparing azoimide, NgH, the hydride of nitrogen isolated last year by Prof. Curtius, of Kiel, have been discovered. As announced at the time in NATURE (vol. zlm p 21), Prof Curtus prepared this remarkable compound by reacting with his previously isolated hydrazine hydrate, N.H. H.O. upon hippuric acid, converting the hydrazine derivative thus obtained into its nitroso-derivative, and decomposing an alkaline solution of the latter with sulphuric acid. An

chair

of us President.

product of the latter operation. In order to obtain the free compound itself, the silver salt was prepared by allowing the distillate to flow into a solution of silver nitrate, and the precipitated silver salt, after drying, was decomposed with sulphunc acid. In a subsequent communication (comp. NATURE, vol xliii. p. 378), Prof. Curtius, in conjunction with Dr. Radenhausen. showed that the pure compound was a very volatile liquid, boiling at 37°, and of fearfully explosive properties. In the current number of the Berichte, Drs. Noelling and Grandmougin, of Mülhausen, publish a preliminary note, in which they describe a new, and from the point of view of its constitution most important, method of preparing the liquid. The phenyl ester of

azomilde is the diazobenzene imide of Griess, C₆H₅—N

just as chlorbenzene is the phenyl ester of hydrochloric acid In view of the great stability of the esters of aromatic radicles. it was hardly to be expected that diagobenzene imide would yield azoimide upon saponification But Drs Noelting and Grandmougin considered that it might be possible to obtain the latter by decomposing a nitro derivative of diazohenzene imide by means of alkalies, inasmuch as the introduction of nitro groups generally effects a considerable increase in the mobility of the acid radicle, rendering its removal by processes of saponification much less difficult. They there fore prepared the dimitro derivative of diazobenzene imide from dinitro-aniline by means of the usual diazo reaction-conversion into the perbromide, and treating with ainmonia When treated with alcoholic potash, this dinitro-diszobenzene imide readily decomposes into the potassium salt of dinitro-phenol and azoimide. Upon acidifying the product of the reaction and subjecting it to distillation, an aqueous solution of azoimide passes over, which may be converted into the anhydrous bound by the method described by Prof Curtius. The properties of the an hydrous azomide obtained by this new method agree completely with those detailed by Prof Curtius

THE second new method of preparing azomide was communicated by I'r Thiele, of Halle, at the Versammlung deutscher Naturforscher und Acrzte, held in that city in September last In the course of an investigation of the compounds

Upon treating this compound with acetic acid and zine dust, it is reduced to amido guanidine, a substance which forms wellcrystallized salts By boiling the latter with soda, decomposition ensues, with formation of free hydrazine, NoH4, which may be very conveniently prepared by this method. Upon subjecting the nitrate to the diazo reaction, the diazo nitrate of guanidine

 CN_8H_{20} and the curious constitution $\stackrel{-}{\downarrow}$ $\stackrel{\parallel}{\downarrow}$ $\stackrel{\parallel}{NH_{2}}$ NH-NThe eros unide may be obtained by distillation in a manner similar to

that described above THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (Macacus simicus &) from India, presented by Mr. W. Harrow, a Macaque Monkey (Macacus cynomolgus) from India, presented by Mrs. Cotton, a Common Marmoset (Hapale jacchus) from South East Brazil, presented by Mrs. Trelawny; a Gannet (Sula bassana), British, presented by Mr. J. Hitchman; a Smooth Snake (Coronella laves) from Hampshire, presented by Mr. F. C. Adams; ten Smooth Snakes (Coronella lavus), born in the Gardens.

NO. 1147, VOL. 44]

OUR ASTRONOMICAL COLUMN.

DISTRIBUTION OF LUNAR HEAT -Mr. Frank H. Very's essay on the distribution of the moon's heat and its variation with the phase, which gained the prize of the Utrecht Society of Arts and Sciences in 1890, has recently been published. bolometer in connection with a very sensitive galvanometer was used in the research, and the plan has been to project an image used in the research, and the plan has been to project an image of the moon about 3 centimeters in diameter by a concave mirror; and to measure, not the heat from the whole of this, but only that in a limited part of it, from \$\frac{1}{2}\$ to \$\frac{1}{2}\$ of the area of the disk, the observations being repeated at different points and at different phases. Measures made as thous after full moon show that the east limb was hotter than the west limb in the proportion of 92 2 to 88 9 In one observation, made a day larger. There is a regular decrement of heat in passing from higher to lower latitudes, and observations on this point appear to indicate that heat is accumulated after many days of tinuous sunshine The heat in the circumferential zone of the In this respect, therefore, the thermal image is like the visual There seems to be so ne evidence that bright regions radiate a little more than dark during the middle of the lunar day, but this is not quite proved, and with a low altitude of the sun the effect is reversed. A comparison of the curve drawn by Zollner for the moon's light with that deduced from Mr Very's observations brings out the point that visible rays form a much larger proportion of the total radiation at the full than at the partial phases, the maximum for light being much more pronounced than that for the heat. The diminution of the heat from the full to the third quarter is shown to be slower than heat from the first quarter to the full. This result agrees with that obtained at Lord Rosse's Observating, and is direct cyldence of the storage of heat by lunar rock-

GEOLOGICAL SOCIETY OF AMERICA TIII. Geological Society of America met at Washington on August 24 and 25 Owing to the death of the President, Prof Alexander Winchell, Vice-President Gilbert took the

chair

The meeting was oj ened with an address on the late President
by his brother, Prof. N. II. Winchell: Alexander Winchell
was born on December 31, 1844, in Dutchess County, N. Y.,
and died at Ann Athor on February 19 last: Ilis work was
may sided. He had studed to be a civil engineer, had a
stong leasing tow-rist theology. Il ea lato read medicine and
was, a the mathematician: He loved missic, wrote poetry, and modelled in clay and plaster. As a financial resource he became at teacher, and was very successful. He became famous by his arguments on "The little History of the Creation," and published in the Christian Advocate." Adamtes and Pre-Adamtes. an exposition of 'criptural and scientific harmony For four as a sposition of 'empirical and scientific harmony bor four years he lectured on gooding at Venderbil University. During years he lectured on gooding at Venderbil University. During wrote hany scientific strictles of a popular nature, and the agreat deal to popularize geological science. The speaker spoke eloquently of his dead brother's long and splended com-sistence of the properties of the properties of the properties of the spoke eloquently of his dead brother's long and splended com-countingly determined. Oddly complete that works the uttered in publis, were these; "When I speak to you again it will be of the inhalisman of number world." He had just infinished his weekly lecture, and referred in his closing sentence to the sub-sequent lecture that was never delivered. He discovered many new geological species, and many other geologists testified their admiration for him by naming after him species they discovered His great work for the Geological Society was touched on, and

to draft resolutions expressive of the Society's regret at the death of the President, and Steinmann, of the University of Freiburg, Germing president first paper, which consisted of the description of a geological map of South America. A large copy of the map was bung up bened the plainform, and small replicas we distributed among the sudence. Dr. Steinmann, who is a young, bezeifed, spectacled, typical German sudent, was sent to

the speaker expressed his conviction that the next generation would keenly feel the beaeficent influence of his brother's work.

At the conclusion of the memorial Prof. Edward Orton, Dr C A. White, and Mr. C. R. Van Hise were appointed a committee

602

South America by the Strasburg University some ten years ago, and spent some two years making a most thorough research in the geology of the continent, the tangible result being the remarkably complete map exhibited. His researches in South America prove that there is a most remarkable similarity South the geology of the two Americas, and especially between the geology of the southern United States and the southern continent.

logy of the southern United States and the sonthern continent. The second paper was by Dr. August Robiplets, of the University of Munich, Germany, on the Peronan, Transie, and Jurassic Formations in the East Indian Archipelago. The doctor's paper was devoted to the description of some Melozone and Paleozoto fossile ciletted in two of the Indian shands by and Paleocote fossils collected in two of the Indian islands by hils friend Dr Wichmann, during a geological exploration of the Islands Dr Wichmann being geologist of the University of Utrecht, Holland, the collections were of particular value, and Dr Rothpletz's description and classification of them, to which he devoted his paper, was thorough and minute. He took occasion to ridicule some of the classifications of fossils which put them in one category when found in one place and in another when found somewhere else.

another when found somewhere eise.
"Thermometemorphism in Igneous Rocks" was the tute of of the next paper presented. It was by M Alfrel Induce of the next paper presented in the present of the produced of the produced the present of the formation of rocks. He described the results of his researches in the lake region of England, where the volcaus forces of nature were particularly

well marked. well marked.

Prof. Alexis Pavlow of the University of Moscow, Russia, presented a paper entitled "Sur les Couches Marines terminant le Jurassique et commençant le Crétace, et sur l'Histoire de leui Faune."

Another paper, also in French, presented by Prof. Max Lohest, of the University of Liege, Belgium, was entitled "Sur l'Homme contemporain du Nammouth en Belgique." The contemporaneous existence of man was supported by proofs

Baron Gerald de Geer, of Sweden, gave an interesting account of recent changes of level along the sea board of the Scandinavian peninsula

Scandinavian peninsula

The most important new matter presented was a paper on

"Fous I Fishes of the Lower Silurian Rocks of Colorado," by

Mr C D Walcott, of the United States Geological Survey

The discovery of the fossil fish remains is of recent date, and The discovery of the fossi fish remans is of recent date, and tartest great attention among scolests and geologist from its carrying halt into the past, over a great time interval, our remains known, and appear to be the ancestral type of the great leishbyte fauns of the classic "old red sandstone" of Europe, and the Deronian group of America.

In the discussion, Profs Von Zittel, Jackel, and P. Schmidt compared the fish remains exhabited with those of the Devonian,

and stated that the Upper Silurian types were not represented an the fauna.

an the fauna.

SECOND DAY — From the committee appointed to draft appropriate resolutions relative to the death of Dr. Alexander executions are considered to the death of the draft and to continue report the place as adopted. The resolutions reported place is and too change tribute to the character of the deceased, and the draft and the this writings and lectores were attributed in a great degree the growing liberality and enlargement of thought of the more serious minded portion of the community in regard to the theory of organic evolution as presented by Darwin and his successors Dr Winchell, the report affirmed, stated and defended with Dr Winchell, the report affirmed, stated and defended with market ability and courage and personaive power this the most market ability and courage and personaive power that the most market personaive control of the personaive compatibility with one of other note fluedamental convintions or compatibility with one of other note fluedamental convintions or compatibility with one of other note fluedamental convintions or compatibility with one of other note fluedamental convintions of the personaive control of disarm hostility by showing that the evolutionary philosophy, so far from degrading and dishonouring man, makes him in a peculiar sense the head and crown of the creation?"

NÖ. 1147, VOL. 44]

In seconding the resolutions Dr. C. A. White paid a warm tribute to Dr. Winchell, with whom he had been on terms of ntimacy for many years. As a further mark of respect the resolutions were adopted by a rising rote. The first paper presented was by Dr. Frederick Schmidt, of

The first paper presented was by Dr. Frederick Schmidt, of S Petersburg, Rasia,
Prof. Gregolor Stefanesen, of the University of Bothsmest,
Roumanns, Prosented "Sur l'Existence du Dhouberfain on Roumannie," the next paper. The Professor read it is French,
illustrating it by drawings on the blackboard, and after he had
finished, Prof Dr Charles Barrois read it over again in English,
so that those who did not know French might not fole it. so that those who did not know French might not lose it. Though quite short the paper was very interesting. It briefly described a large number of bones of the Dinotherium found underly distributed over Roumania, which indusputably pointed to the existence of this almost unknown extinct animal is that to the existence of this almost unknown extinct animal in that land counties, years ago. This was probably the largest manmal and counties, years ago that the largest largest manmal as that enormous tusks, that curved downward and backward in such a way that it could only largest largest probably had a massive trunk. In character is more nearly resembled the elephant and rhinoceros of modern ages than any other known

Prof A. N Krassnof, of the Charkow University, Russia, read the next paper on the black earth of the steppes of Southern read the next paper on the black earth of the stoppes of Southern Russa, it origin, distribution, and points of resemblance with the state of the state of the state of the state of the state resemblance between the Russian steppes and the Acadeba praints to their similar origin in the layers of the vegetage of years. Their remarkable fertility was touched on generally, and a technical account of the origin of the two plans with oiven.

TECHNICAL CHEMISTRY.

IN his Cantor I ectures on Photographic Chemistry, delive e last spring before the Society of Arts, and just issued by the Society in a separate form, Prof. Meldola opens with some

Society in a separate form, Prof. Melilola opena with some remarks on the special position of technical training in chemistry, which should be catefully considered in connection with present wide-percal movement in the direction of technical process of the present wide-percal movement in the direction of technical control of the percal wide percal percal with the process of the percal wide percal p Now, in order to give technical instruction in a subject like photo-Now, in order to give technical institution in a support line purious graphy, which is so intimately connected with chemistry, we may adont one of two courses. I be student may become a practical graphy, shoch is to intimately connected with chemistry, we may adopt one of two courses. The vident may become a practical photographer in the first place, and may then be fed on to the property of the pro

analytical method may be, and has been, adopted with success, it is possible to lead an intelligent mechanic from his very day occupation to a knowledge of the higher principles of methods are not by making use of law experience of phenomena control of the principles of methods are not been as the principles of methods are not been as the principles of the control of the principles of th

general principles to start with. No person who is not grounded in such broad principles can properly appreciate the explanation of the phenomena with which his daily ex-perience brings him into contact, and if his previous traising it has difficult to enable him to understand the nature of the changes which occur in the course of his operations, be cannot derive any advantage from technical instruction. These remarks will, I hope, serve to emphasize a distinction which exists between technical chen.lsiry and other technical subjects, and I have thought it desirable to avail myself of the present oppor-tunity of calling particular attention to this point, because it is one which is generally ignored in all discussions on technical

education.

"The reason for this difference in the mode of treatment of chemical subjects is not difficult to find. The chemical tech chemical subjects is not difficult to find. The chemical tech nologist—the man who is engaged in the manufacture of useful product out of certain raw materials—is, so far as the purely identified principles are concerned, already at a very advanced chemilisty of manufacturing operations, even when there are of an apparently sumple kind, is of a very high order of complexity. There are many branches of chemical industry in which the matter of the chemical changes undergone by the materials is an authority of which the puts centre can be said to be thoroughly more for the product of the chemical industry in which the state of the chemical changes undergone by the materials is a state of the chemical chemical changes in the state of the chemical chemical changes in the state of the chemical chemical three that I am justified in stating that the chemical is chemically as well as the chemical consideration which have been offered apply to the special subject of photography with fall force. A person to the special subject of photography with full force. A person may become an adept as an operator without knowing anything may occome an adept as an operator without knowing anything of physics or chemistry, there are thousands of photographers all over the country who can manipulate a camera and develop and print pictures with admirable dexterity, who are in this position. If we adopt the narrow definition of technical instrucpostdon. If we adopt the narrow definition of rechnical instruction, we should appoint such experts in our Colleges, and through them impart the art of taking pictures to thousands of the property of the process. I work the process is the process of the process

AN ASTRONOMER'S WORK IN A MODERN OBSERVATORY

THE work of astronomical observatories has been divided into two classes, vr., satrometry and satrophysics. The first of these relates to astronomy of precision, that is to the determination of the positions of celestial objects, the second relates to the study of their physical features and chemical

Some years ago the aims and objects of these two classes of observatories might have been considered perfectly distinct, and, in fact, were so considered. But I hope to show that in more in fact, were so considered. But I hope to show that in more recent years their objects and other processes have become so intrinsed that they cannot with advantage be direded, and a fact of the state of the state

or with amounts instruments, that the writter hard superstructure of exact astronomy rests, that is to say, all that we find of information and prediction in our natificial almanaes, all that we know of the past and can predict of the future motions of the celestial bodies.

¹ Friday Evening Discourse delivered at the Royal Institution by D David Gill, F.R.S., Her Majesty's Astronomer at the Cape of Good Hop on May to , 1801.

Here is a very small and imperfect model, but it will serve to render intelligible the photograph of the actual instrument which will be subsequently projected on the screen. [Here the lecturer described the adjustments and mode of using a trainit

curcle]
We are now in a position to understand photographs of the matitiment itself. But first of all as to the house on which the death. Here, now of the vectors is the counted of the main careful and the property of the counter of the state of the s see, an admirably solid and substantial structure, innocent of any architectural chaim, and so far as it affords an excellent dwelling place, good library accommodation, and good roomsfor computers, no fault can be found with it. But these very computers, no tault can be found with it. But these very qualities render it undesirable as an observatory. An essential matter for a perfect observatory should be the possibility to equalize the internal and the external temperature. The site of an instrument should also be few. surroundings of chimneys or other origin of ascending currents of heated air. Both these conditions are incompatible with thick walls of masonry and the chimneys of attached dwelling houses, and therefore, as far as possible, I have removed the instruments to small detached houses of their own. But the transit circle still remains in the main building, for, as will be evident to you, it is no easy matter to transport such an

The two first photographs show the instrument, in one case pointed nearly horizontally to the north, the other pointed rearly vertical Neither can show all parts of the instrument, but you can see the massive stone piers, weighing many tons cach, which, resting on the solid blocks to feet below, support the pivois Here are the counter weights which remove a great part of the weight of the instrument from the pivots, leaving part of the weight of the instrument from the pivots, leaving only a residual pressure sufficient to rotable the protot preserve the motion of the instrument in its proper plane. Here are the motion of the instrument vews the moridan sty. The through which the mutument vews the moridan sty. The through which the mutument vews the moridan sty. The too the very simple, and so it it, but it requires special natural gift, patience and devotion, and a high sense of the importance of ins work to make a first rate meridant observer. Nothing apparently more monotonous can be well imagined if a man it not to the manner born.

"not to the manner born" Having directed his instrument by means of the setting circle to the required altitude, he clamps it there and waits for the slar which he is about to observe to enter the field. This is what he sees. [Artificial transit of a star by lantern]

what he sees. [Artinicial transis of a sign by lantern]
As the star enters the field it passes were after wire, and as
it passes each wire be presses the key of his chronograph and
records the instant automatically. As the star passes the
middle wire he bisects it with the horizontal web, and again similarly records on his chronograph the transit of the star over the remaining webs. Then he reads off the microscopes by which the circle is read, and also the barometer and thermometer, in order afterwards to be able to calculate accurately the effect an oater alterwards to be able to calculate accurately the Endough and an able to calculate accurately the Endough and the has observed goes on, sits after star, hour after hour, and pull after sight; and, as you see, it differs very widely from no dreamy contemplation, no watching for new stars, so consequently externing phenomena. On the contrary, there is unexpected or startling phenomena. On the contrary, there is the previously calculated circle setting for each star, allowing put sufficient unite for the new setting for the real star after the readings of the circle for the previous observation.

The previously calculated circle setting for each star, allowing on the cough of it; they have, perhaps, observed fifty or any stars, they determine certain sustrumental errors, and betake them, and contented man, At the Chey we couply two observers—one to read the circle, and one to record the instant. Four oversers are sumply, each alternove to read the circle, and one to record the instant. Four oversers are sumply, each alternove to read the circle, and one to record the instant. Four oversers are sumply, each alternove to read the circle, and one to record the instant. Four oversers are sumply, each alternove to read the circle, and one to record the instant. of atmospheric refraction on the observed altitude of the star

would find out, if he came nest morning, that the work was by no means over. By far the largest part has yet to follow An observation that requires only two of these minutes to make at night, requires at least half an hoar for its reduction by day, have to be determined and allowed for. Although solidly founded on massive plear resting on the solid rock, the constancy of the hautement's postion cannot be relied upon. It goes through small periodic changes in level, in collimation, and in aimunit, which have to be determined by proper means, and the corresponding corrections have to be computed and applied; the provides of the prov and, also, there are other corrections for retraction, dun which movive comparistion and have to be applied. But these matters would fall more properly under the head of a special lecture upon the transit instrument. I mention them now, merely to explain why so great a part of an astronomer's work comes in the dayline, and to dispel the notion that his work belongs only

One might very well occupy a special lecture in an secount of the peculiarities of what is called personal equation—that is to say, the different time which elapses for different observers say, the different time which elapses for different observers between the time when the observer believes the star to be upon the wire, and the time when the finger responds to the message which the eje has conveyed to the brain. Some observers always pires the key too soon, some always too late Some years ago of lateversed, from observations to which I will subsequently refer, that all observers press the chronograph key either too soon for bright was not too late for fraint ones.

either too soon for bright stars or too late for faint ones. Other errors may, and I am sure do, arise both at Greenwich and the Cape, from the imposs thinly of securing uniformity of The Ideal Observatory should be volid as possible as to its fundations, but light as possible as to its roof and walls—say, a light framework of time covered why canwas. But it would be undescrible to cover a valuable and permanent instrument in

this way

But here is a form of observatory which realizes all that is But here is a form of observatory which realizes all that is tequired, and which is emmently suited for permanent use. The walls are of sheet trop, when he reality acquire the tenther than the same of the same

The photograph now on the screen shows the interior of the observatory, and this brings me to the description of observations of an entirely different class. In this observatory the roof tions or an entirely different class. In this observatory the roof turns round on wheely, so that any part of the sky can be viewed from the telescope. This is so, becau e the instrument in this observatory is intended for purposes which are entirely different from those of a transit crefe. The transit circle, as we have seen, is used to determine the absolute positions of the heavesly hodies; the heliometer, to determine with greater precision than is possible by the abs lute method the relative positions of celesiisl objects

To explain my meaning as to absolute and relative positions. It would, for example, he a matter of very little importance if the absolute latitude of a point on the Royal Exchange or the Bank of England were one tenth of a second of arc (or 10 feet) wrong in the maps of the Ordnance Survey of England—that would constitute a small absolute error common to all the buildings on the situte a small absolute error cosimon to all the buildings on the same map of a part of the city, and common to all the adjoining maps also. Such an error, regarded as an absolute error, would evidently be of no importance if every point on the map had the same absolute error. There is no one who cut say at the present moment whether the absolute latitude of the Royal Exchange nny, even of the Royal Observatory, Greenwich—is known to 10 feet. But it would be a very serious thing indeed If the re-To the control works are expressed in the feet of the control works are expressed in the feet of the control works are expressed in the feet of the control works are feet of the control

We do not know, we probably never shall know with cer-lainty, the absolute places of even the principal stars to one-teath tainty, the assume places of even in the transport of a second of arc. But one tenth of a second of src.in, the measure of some relative position would be fatal. For example, in the measurement of the sun's parallax an error of one tenth of a second of are means an error of 1,000,000 miles, in round

numbers, in the sun's distance; and it is only when we can be quate certain of our measures of much smaller quantities than con-centum of a second of are, that we are he a position to begin serrously the determination of such a problem as that of the distances of the Seed stars. For these problems we must use differential measures—that it, measures of the relative positions of two objects. The note perfect featurement for such purposes

is the beliometer.

Lord McLaren has kindly sent from Edinburgh, for the put poses of this lecture, the parts of his heliometer which are necessary to illustrate the principles of the instrument This instrument is the same which I used on Lord Crawford's

Ins instrument is the same which I used on Lord Crawford's expedition to Mauritus in 18/4. It was also kindly lent to me by Lord Crawford for an expedition to the I-land of Ascension to observe the opposition of Mars in 18/7. In 18/9, when I went to the Cape, I acquired the instrument from Lord Crawford, and carried out certain researches with it on the distances

of the laxed stars.

In 1887, when the Admiralty provided the new heliometer for the Cape Observatory, this instrument again changed hands. It became the property of Lord McLaren I felt rather disloyal in parting with two old a friend. We had spent so many happy hours together, we had shared a good many anxested together, and two hours each other's weatherners or well. But my old rineral has fallen into good hands, and has found another sphere of work.

The principle of the instrument is as follows [The instrument was here explained]

There is now on the screen a picture of the new heliometer of the Cape Observatory, which was mounted in 1837, and has been in constant use ever since. It is an in-trument of the most refined modern construction, and is probably the fasest apparatus for refined measurement of celestial angles in the world.

[Here were explained the various parts of the instrument in relation to the model, and the actual processes of observa-tion were illustrated by the images of artificial stars projected on

and new illustrated by the images of articulas stars projected out of an attraction of a stronger work, there is no searching for objects, no contemplative watching, nothing sensational of any tind. On arranged and calculated beforehand, and the prospect that lies before him in him upth's work is imply more of less of a struggle with the difficulties which are created by the agustion of the tars image, consect by presipilities in historic difficulties which are created by the agustion of the tars are perfectly tranquil. You have the same effect in an exaggenistic way when looking across a bog on a hot day. Thus, generally, as the images are approximately, they appear to a moment of comparative tranquility to make he definitive bisection, or he may arrive at it by gradual approximations till he did that the wheating images of the two strus seems to pass a bisection has been made, the time is recorded on the chronic praph, there the scales are ponted on and printed off, and so the graph, then the scales are pointed on and printed off, and so the work goes on, varied only by reversals of the segments and of the position circle Generally, I now arrange for thirty-two such hisections, and these occupy about an hour and a half. By that time one has had about enough of it, the nerves are somewhat tired, so are the muscles of the back of the neck, and if the observer is wise, and wishes to do his best work, he goes to observer is wise, and wishes to do his best work, he goes to beed early and gets up again at two or three colon. In the morn-ted of the colon of the colon of the colon of the colon must be his regular outine night after night, whenever the weather is clear, if he is regulaged, as I have been, on a large programme of work on the parallaxes of the fixed stars, or on observations to determine the distance of the sun by observations.

of minor planets,
I will not speak now of these researches, because they are still in process of execution or of reduction. I would rather, in the first place, endeavour to complete the picture of a night's

in the heat place, endeavour to complete the picture of a magneta work in a modern observatory.

We pass on to celestial photography, where astrometry and astrophysics join hands. Here on the screen is the interior of one of the new photographic observatories, that at Paris, [Brief

one or one new photographic observatories, that at Paris, [Brief description.]

Here is the exterior of our new photographic observatory at the Cape. Here is the interior of it, and the instrument. [Brief description.]

The observer's work during the exposure is simply to direct het telescope to the required part of the sky, and them the school to the required part of the sky, and them the school helds in his had a little electrical switch with two keys; by pressing one key he can accelerate the velocity of the driving-rower by about 1 per cent;, and by pressing the other he can the field always, perfectly listected by the cross worse of his gainty letter, and the school performance of the school

panionamp of a pipe or coger is very helpful during long ex-posures. A man can go on for a watch of four or five hours very well, taking plate after plate, exposing each, it may be, forly minutes or an hour. If the might is fine, a second observer follows the first, and so the work goes on the greater part of the might. Next day be developed his plate, and gets something like [Star-cluster.]

Working just in this way, but with the more humble apparatus which you see imperfectly in the picture now on the screen, we have photographed at the Cape during the past six years the whole of the southern hemisphere from 20° of south declination to the South Pole

The plates are being measured by Prof. Kapteyn, of Groningen, and I expect that in the course of a year the whole work, containing all the stars to 9½ magnitude (between 200,000 and containing all the stars to 9g magnitude (between 200,000 and 300,000 sizes) in that region, will be ready for publication. This work is essential as a preliminary step for the execution in the southern liminsphere of the great work inaugurated by the Astrophotographic Congress at Paris in 1887, it hast details of which were settled at our meeting at Paris in 1887, it hast details of which were settled at our meeting at Paris in 287, it has the details of which were settled at our meeting at Paris in April last. What we shall do with the new apparatus, perhaps I may have the honour to describe to you some years hence, after the work has been done

We now come to an important class of astronomical work, more purely astrophysical, for the illustration of which I can no longer appeal to the Cape, because I regret to say that we are not yet provided with the means for its prosecution. I refer to the use of the spectroscope in astronomy, and especially to the latest developments of its use for the accurate measurement of the velocity of the motions of stars in the line of sight.

the velocity of the motions of stars in the line of signs. It is beyond the province of this lecture to enter into history, but it is impossible not to refer to the fact that the chief in pulse to astronomical work is this direction was given by Dr Huggins, our Chairman to night—nay, more, except for the early contributions of Fraunhofer to the subject, Dr Huggins certainly is the faiter of sidereal spectroscopy, and that not in one but in every branch of it. He has devised the means, pointed the way, and, whilst in many branches of the work he still continues to lead the way, he has of necessity left the development of other branches to other hands.

From an astronomer's point of view the most important advance that has been made in spectroscopy of recent years is the in the line of sight The method remained for fifteen or sixteen in the line of sight. The method remained for fifteen or sixteen between the condition or which it left the hands of Dr. Huggers, and certainly no progress in the accuracy Dr. Vogel at 7 Foodban. As a single step Dr. Vogel at 8 Foodban. As a single step Dr. Vogel at his nased the precision of the work from that of observations in the days of Prolemy to that of the days of Bradley-from the days of the old nights and pinnish to the days of telescopes. Therefore, takes Production observation as the best type of a modern over-time of the days of telescopes. fore I take a Possum observation as the new type or a mount spectroscopic observation for description, especially as I have recently visited Dr. Vogel at Postdam, and he has kindly given me a photograph of his spectroscope, as well as of some of the work done with it.

work done with it.

A photograph of the Poisdam spectroscope attached to the
equational is now on the screen. [Description, Insenting a small
photographic plate in the dark slide, durifulty the intercope to
the star, and keeping the image of the star continuously on the
star, and keeping the image of the star continuously on the
star it during an exposure of about an hour 3 and that I what is
obtained to development of the pleture.

If the star remained perfectly a text between the jaws of the

The older methods enablad us to measure motions at right angles to th line of night, but till the spectr, scope came we could not measure motions is the line of sight

NO. 1147, VOL. 44]

slit the spectrum would be represented by a single thread of light, and of course no lines would be visible upon such a thread; but the observer intentionally causes the star image to

thread; but the observer intentionally causes the star image to travel a little along the sit durang the time of expective, and so a spectium of sentille width is obtained. Voo-wall reasts how beautifully sharp are the faint lines in this spectium. Those who have tried to observe the spectium of Subra in the ordinary way, know that many of these fine lines cannot be leven or measured with cettainty. The reason is that on account of thregolutine in a sharpheter draftection, the image on account of veregularities in atmospheric refraction, the image of a star in the telescope is rarely tranqui, sometimes it shines brightly in the centre of the sist, sometimes barely in the allt at all, and the eye becomes puzzled and confused. But the photographic eye is not in the least disturbed, when the star image is in the allt, the plate goes on recording what it sees, and when the star is not in the slit the plate does nothing, and it is of no the star is not in the slit the plate does nothing, and it is of no consequence whatever how rapidly these alternate appearances and disappearances recur The only difference is that when the air is very steady and the star's image, therefore, always in the slt, the exposure takes less time than when the star is unsteady.

That is one reason why the Potsdam results are so accurate And there are many other reasons besides, into which I cannot And nere are many other reasons sensity, into which I cannot now ecter. What, however, it is very important to not es that, that we have here a method which is to a great extent independent of the statiospheric disturbances which it is all other departments of astronomical observation have imposed a limit to their precision. Accurate satiropeterioscopy, therefore, my le-pushed to a degree of perfection which is limited only by the optical and at our disposal and by the sensibility of our photo-potical disposal and by the sensibility of our photo-

graphic plates.

graphic plates.

And now I think we have sufficiently considered the ordinary processes of astronomical observation to illustrate the character processes of astronomical observation to illustrate the character completed by an account of his work by day, but to go into that matter in detail would certainly not be within the limits of his lecture. It is better that I should in conclusion touch upon this iccurre. It is better that I should in conclusion touch upon some recent remarkable results of these day and night labours. It is these after all that most appeal to you, it is for these that the astronomer labours, it is the prospect of them that lightens the long watches of the night and gives life to the otherwise. dead bones of mechanical routine

l et us take first some spectroscopic results To explain their meaning let me remind you for a moment of the familiar analogy between light and sound

The puch of a musical note depends on the rapidity of the

vibiations communicated to the air by the reed or string of the musical instrument that produces the note, a low note being musical instrument that produces the note, a low note being given by slow with attons and a high one by quick vibrations.

Just in the same way red light depends on relatively slow wibrations of ether, and blue or violet light on relatively quick vibrations. Well, if there is a railway train rapidly approaching one, and the engine sounds its whistle, more waves of sound from that whistle will reach the ear in a second of time than would reach the ear were the train at rest. On the other hand, if the train is travelling at the same rate array from the observer, fewer waves of sound will reach his eass in a second of time.

Therefore an observer beside the line should observe a distinct change of puch in the note of the engine whistie as the train be and has been observed.

Just in the same way, if a source of light could be moved rapidly enough towards an observer it would become bluer, or if away from him it wou'd become more red ia colour Oaly it If away from him it wou'd become more red as colour. Only it would require a change of velocity in the moving light of some control of the control of the control of the control of colour sensities to the eye. The experiment us, therefore, not hiely to be frequently shown at that lecture table?

But the spectroscope enables such changes of colour to be most appended illustration of the that central represent, vis. copies of three negatives of the spectrum of a Ausige, taken a Topishman to October and December of 1888, and in March Population.

1889. "Black line (the picture being a negative) represents the bright line Hy given by the artificial light of hydrogen, the strong white line in the picture corresponds to the black absorption line which is due to hydrogen in the atmosphere.

Why is it that the artificial hydrogen line does not correspond

with the stellar line in all these pletures? The answer is, either the size is moring towards or from the surch in the line of succession to the surch in the line of succession the surch in the line of succession the surch in the surch condition to the discussion of a Aurigez why then does not the surch line and the surch line surch in position with the terrestrial moving with respect to the engineering in the a Aurige is moving with respect to the surch with the surch line and the surch line is successive. Well, that also is clear; the stellar line is displaced towards the red end of the spectrum—surch line is successful to the surch line in the surch line is successful to the surch line in the surch line is successful to the surch line in the surch line is successful to the surch line in the surch line is successful to the surch line in the surch line is successful to the surch line in the surch line is successful to the surch line in the surch line is successful to the surch line in the surch line is surch line in the surch line in the surch line is successful to the surch line in the surch line is successful to the surch line in the surch line is successful to the surch line in the surch line is successful to the surch line in the surch line is successful to the surch line in the surch line is successful to the surch line in the surch line is successful to the surch line in the surch line is successful to the surch line in the surch line is successful to the surch line in the surch line is successful to the surch line in the surch line is successful to the surch line in the surch line is successful to the surch line in the surch line is successful to the surch line is successful to the surch line in the surch line is successful to the surch line is success

that is to say, the star light is redder than it should be in con-sequence of a motion of recession, this proves that the star is moving away from us, and measures of the photograph show the rate of this motion to be 15½ miles per second. We also know that in October the earth, in its motion round the san, is mov-ing towards a Aurige in raining away from the sam. Conse-seen that a Antige is raining away from the sam. quently, at that time, their relative motions are nearly in-sensible, because both are going at the same rate in the same direction, and we find accordingly in October that the positions direction, and we find accordingly in October that the positions of the stellar and artificial hydrogen lines perfectly correspond Finally, in March, the earth, in its motion round the san, is moving away from a Aunge, and as a Aunge is also running away from the sun, the star-light becomes so much redder than normal that the stellar hydrogen line is shifted completely to one side of the hydrogen and artificial line.
The accuracy of these results may be proved as follows.

If we measure all the pho'ographs of a Aurigae which Dr Vogel has obtained, we can derive from each a determination of the relative velocity of the motion of the star with respect to our

Of course these velocities are made up of the velocity of motion of a Aurigo with respect to the sun (which we may reasonably assume to be a uniform velocity) and the velocity of reasonably assume to be a uniform velocity) and the velocity of the earth due to its motion round the sam. But the velocity of the earth's motion in its orbit is known with an accuracy of about one fire-hundredth part of its amount, and therefore, within that accuracy, we can allow precisely for its effect on the relative relocity of the earth and a Aurige When we have done so we get the following results for the velocity of the motion of a Aurige with respect to the sun. You see by the following table how beautifully they agree in the Potsdam results, and how comparatively rough and unreliable are the results, and by the older method at Greenwich —

a Aurage - Potulam a Aurigic Fro
Observed relative
motion of
earth and star
Miles per sec.
+ 2'5
+ 31
+ 3'1
+ 25
+ 68 Motion of Concluded motion carth Date 1886 October 22 1 15 5 + 15 5 + 15 5 24 - 12'4 25 28 - 12 4 - 11 8 + 14 3 November 9 8 7 December i + 118 3 1 + 14 9 13 + 149 ñ'6 .. 1399 January 2 ... + 205 + 63 + 13 7 February 5 + 32'9 + 14 3

March 0		T 34 2	-	10 8	T 1/4
		a Auriga-Gre	cmv.	ch.	
Date. 1887		Observed relative motion of earth and star Miles per sec		ion of	Concluded motion. Star relative to the
Tanuary 25		+ 164	+	13.6	+ 38
		+ 34'4		15 9	+ 18 5
		+ 39.8	-	13 5	+ 52 3
		+ 25'4		130	+ 38 4
1888		+ 40 6	-	12 1	+ 52 7
December 7		+ 290	-	1 2	+ 36 2
February 15		+ 238	+	16 o	+ 78
March 5		+ 20'3		17'1	+ 32
September 17		+ 18.6	_	13 3	+ 33 3
., 19		+ 21 8	-	16 7	+ 38 5
,, 25	•••	+ 24 8	_	16.5	+ 41 3
November 25	٠.	+ 24'5		4'9	+ 29'4

NO. 1147, VOL. 44

I believe that in a few years—at least, in a period of that that one may hope to see—we shall not be content merally that the may be the seement and the seement and the seement of the se mise the fundamental unit of astronomy, the distance of the sun from the earth.

I will take as another example one recent remarkable spectro-

scople discovery.

Miss Maury, in examining a number of photographs of stellar

spectra taken at Harvard College, discovered that in the spectrum of β Aurigor certain lines doubled themselves every two days, becoming single in the intermediate days. Accurate Potsdam observations confirmed the conclusion.

dam observations consument the conclusion.

The picture on the screen shows the spectrum of B Aurigor photographed on November 22 and 25 of la-1 year. In the first the lines are single, in the other every line is doubled. Measures and discussion of a number of these photographs have shown that life doubling if the lines it perfectly accounted for by the supposition of two suns revolving round each other in a period of four days, each moving at a velocity of about 70 miles a second in its orbit

a second in its orbit

When one star is approaching us and the o her receding, the
lines in the spectrum formed by the light of the first star will be
moved towards the blue end of the spectrum, those in the spectrum of the second star towards the red end of the spectrum trum of the second star towards the red end of the spectrum. Then, as the two stars come into the same inwe whi us, therm too those become at right angles to the line of ught, and their two spectra, not beleg affected by motion, will perfectly connected, but then, af er the stars cross, their spectra again separate in the opposite direction, and so they go on.

Thus by means of their spectra we are in a position to watch and to measure the relative motions of two objects that we can

and to measure the relative motions of two objects that we can never see apart—nay more, we can determine not only their period of revolution, but also the velocity of their motions in their orbits. Now, if we know the time that a hody takes to complete its revolution, and the velocity at which it moves, clearly we know the dimensions of its obtity and if we know the dimensions of an orbit we know what attractive force is neces dimensions of an orbit we know what attractive force is necessary to compel the body to keep in that orbit, and thus we are sary to compel the body to keep in that orbit, and thus we are two suns, which revolve about each other in four day, they are only between 7 and 8 millions of mitter (or one-tweight of our distance from the sun) apart, and if they are of equal weight they each weigh rather over double the weight of

I have little doubt that these facts do not represent a per-manent condition, but simply a stage of evolution in the life-history of the system, an earlier stage of which may have been a pebular one

Other similar double-stars have been discovered both at Potsdam and at Cambridge, U.S., stars that we shall never see separately with the eye aided by the most powerful telescope; but time does not permit the to enter into any account of them I pass now to another recent result that is of great cosmical

Il pass now to another recent result that us of great comincia. The Case photographic atta-charing of the southers hearisphore has been already referred to. Good with the photographic decremenations of these magnitude by Dr. Good with the photographic decremenations of these magnitudes, both Prof. Kaptporn and the control of the style-that a, m the Milky Way—the stars are systematically the control of the style-that a, m the Milky Way—the stars are systematically thought as the control of the style-that a, m the Milky Way—the stars are systematically thought as the control of the style-that are started. One of two things was estimated. One of two things was estimated that the expension of two the started of the started of a magnitude. One of two things was estimated that the expension of the phase that the expension of the started of Pickering, and the started of the started of Pickering and experience of the phase of Pickering as precionce of Darrobancterang were enablised on the science. It is that discussed the various types of the speace, of the be lighter states, as cased the various types of the speace, of the be lighter states, as desired to the science of the started of the start

Milky Way, whilst stars of other types are fairly divided over

the sky.

Now, it as of the Sirius type are very white it are, very rich, relative to other stars, in the rays which act most strongly on a photographic plate. Here, then, is the explanation of the results of our photographic star-charting and of the discordance between the photographic and visual magnitudes in the Milky the photographic and visual magnitudes in the Milky

The results of the Cape charting further show that it is not alone to the brighter sixrs that this discordance extends, but it extends also, though in a rather less degree, to the fainter stars of the Milky Way Therefore, we may come to the very re-markable conclusion that the Milky Way is a thing apart, and that it has been developed perhaps in a different manner, or more probably at a different and probably later epoch, from the rest of the sidereal universe

Here is another interesting cosmical revelation which we owe

Here is another interesting counts a servanous most photography to photography the beautiful contellation Orono, and many in this thearer have before seen the photograph of the nebula which is now on the screen, taken by Mr. Roberts.

Here is another photograph of the same object, taken with a much longer reposure. You see how over-copone, in fact when the property of the property of the property of the content of the property of the content of the property revealed

reveaue:
But I do not think that many persons in this room have seen
this picture, and probably very few have any idea what it represents. It is from the original negative taken by Prof Pro-tering,
with a small photographic lens of short focu, after six hours
exposure in the clear au of the Audes, to,coo feet above sea

The field embraces the three well-known stars in the belt of Orlon, on the one hand, and A Orionis (Rigel) on the other You can hardly recognize these great white patches as stars, their Ill defined character is simply the result of excessive over But mark the wonders which this long exposure with exposure a lens of high intrinsic brilliancy of image has revealed is the great nebula, of course terribly over-exposed, but note its woulderful fainter ramifications. See how the whole area is more or less nebulous, and surrounded as it were with a ring fence of nebulous matter. This nebulosity shows a special concentration about & Orionis.

Well, when Prof Pickering got this wanderful picture, know ing that I was occupied with investigations on the distances of the fixed stars, he wrote to ask whether I had made any obser vations to determine the distance of & Orionis, as it would be of great interest to know, from independent evidence, whether this very bright star was really near to us or not. It so happens that the observations were made, and their definitive reduction that the observations were made, and their dennitive reduction has shown that \$\beta\$ Orionis is really at the same distance from us as are the faint comparison stars. \$\beta\$ Orionis is, therefore, probably part and parcel of an enormous system in an advanced but incomplete state of stellar evolution, and that what we have seen

incompete state of stemar evolution, and that what we have seen in this wooderful picture is all a part of that system I should explain what I mean by an elementary or by an advanced state of stellar evolution. There is but one theory of celestial evolution which has so far survived the test of time and companison with observed facts, viz the nebular hypothesis of Laplace Laplace supposed that the sun was originally a huge gaseous or nebulous mass, of a diameter far greater than the orbit of Neptune. I say originally-do not misunderstand me orbit of Neptune. I say originally—do not misinderstand me We have finite minds, we can imagine a condition of things which might be supposed to occur at any particular instant of time however remote, and at any particular distance of space however great, and we may frame a theory beginning at another time at Il more remote, and so on. But we can never imagine a

time at II more remote, and so on. But we can never imagine a theory beginning at an infinite distance of time or at an in finitely distance point in or at an in finitely distant point in space. Thus, in any theory which may with his finite mond can devise, when we can do organized to the contract of our present system. The central part of this ball was certainly much more condensed than the rest, and the whole ball revolved. There is nothing improbable in this hypothesis. If gaseous

matter came together from different parts of space, such coalttion wou'd unquestionably occur, and as in the meeting of oppo-site streams of water or of opposite currents of wind, vortices would be created, and revolution about an axis set up, such as we are familiar with in the case of whirlpools or evelones. The resultant would be rotation of the whole globular gaseous mass

shout on ave. Now this gaseous globe begins to cool, and as it cools it reessarily contracts. Then follows a necessary result of connecessarily contracts traction, viz the rotation becomes more rapid This is a wellknown fact in dynamics, about which there is no doubt known meet in dynamics, about which there is no doubt. Thus, the cooling and the contracting go on, and, simultaneously, the velocity of totation becomes greater and greater. At last the time arrives when, for the outside particles, the velocity of rotation becomes such that the centrifugal force is greater than the attractive force, and so the outside particles break off and form Then, as the process of cooling and contraction proceeds still further, another ring is formed, and so on, till ceeds still further, another ring is formed, and so on, till we have, finally, asuccession of rings and a condensed central ball, have finally, asuccession of rings and a condensed central ball, on uniformly, or if some of the gaseous matter of the ring is more easily liquefied than other, then probably a single nucleus of liquid nutter will be formed in that ring, and this nucleus will finally, by ntraction, absorb, the whole of the matter of will many, by netraction, amount the whole of the matter of which the ring is composed—at first as a ga eous hall with a condensed nucleus, and this will finally solidify into a planet, Or, meanwhile, this yet unformed planet may repeat the lustory of its parent sur By contraction, and con equent acceleration of its rotation, it may throw off one or more rings, which in like manner condense into satellites like our moon, or those of Jupiter, Saturn, Uranus, or Neptune Such, very briefly outjapiter, Saturn, Uranus, or Neptitute Such, very briefly out-lined, is the celelizated hebular hypothesis of Laplace. No one can postively say that the hypothesis is true, still less can any-one say that it is untrue. Time does not permit me to enter ian the very strong proofs which Laplace urged in favour of its oci entence

acceptance.

But I beg you for one moment to cast your imaginations back
to a period of time long antecedent to that when our sun had
begun to disentangle itself from chaos, and when the fleecy
clouds of cosmic stuff had but commenced to rush together. What should we see in such a case, were there a true basis for the theory of Laplace? Certainly, in the first place, we should have a huge whirlpool or cyclone of cosmic gaseous stuff, the formation of rings, and the condensation of these rings into gaseous glot es.

Remembering this, look now on this wonderful photograph of the nebula in Andromeds, made by Mr Roberts. In the largest telescopes this nebula appears simply as an oval patch of nearly uniform light, with a few dark canals throught it, but no idea of its true form can be obtained, no trace can be found of idea of its true form can be constant, no trace can be found of the significant story which this photography lells. It is a picture that no human eye, unaided by photography, has ever seen. It is a true picture drawn without the intervention of the hand of fallfible man, and unufluenced by his bias or imagination. Have we not here, so at lesst it seems to me, a pacture of a very early stage in the evolution of a standbutter or sun-system—a phase in the history of another star system similar to that which once occurred in our own-millions and millions of years ago, when our earth, nay, even our sun itself, "was without form-and void," and "darkness was on the face of the deep."

During this lecture I have been able to trace but very imper-fectly the bare outlines of an astronomer's work in a modern secus sine ware outlines of an astronomer's wo.k in a modern observatory, and to give you a very few of its fatest results-results which do not come by chance, but by hard labour, and to men who have patience to face dull daily routine for the love of science—to men who realize the imperfections of their methods, and are constantly on the alert to improve them

The mills of the astronomer grind slowly, and he must be

mills of God, to grand exceeding small
I think be many well take for his motto these beautiful lines.—

" Like the star Like the star
Which shines afar,
With an hasse,
Without rest,
I et each man whiel
With steady sway.
R and the task
Which rules the day,
And do his best "

SOCIETIES AND ACADEMIES. PADIO

Academy of Sciences, October 12 -M Duchartre in the Academy of Sciences, October 12—M Duchartre in the chair—On the theory of the antagonism of vasial fields, by M A. Chauweau—An apparatus for carrying out various experiments connected with the study of binocular contrast, by the same author. The instrument described is that used by M. Chauveau in the experiments the results of which were communicated to the Academy on September 7 and 21 main it consists of a stereoscope having arrangements by means of which exact equality of luminous impressions may be realized, and the colours of the two fields altered independently —New secon of sotherms for earbonic acid, by M. E. H. Amagat. The author has determined the isotherms of carbonic acid for every 10° from 0° to 100°, and also those corresponding to 32°, 35°, 137°, 198°, and 258°; the pressures having been taken up to 1000 atmospheres The results obtained are graphically shown in the accompanying figure, in which the abscisse represent pressures, and products of P x V furnish the ordinates — Valiation



of the composition of Jarusalem attached at a different periods of their growth. "At of the leaves, by M. G. Lechanier. Analyses of the dried black less made, and the results compared with analyses of green and jellow leaves. The effect of different fertilizer on their composition has also been studied. It appears that the back investment that the series of the series of the period of the period of the substance which they lose are utilized for the natural of the higher leaves of the plants. They preserve period of the plants of the period of the per that the black leaves must have had the same composition as

tion" for observations of stellar points and disks under different ployed His equation was very different when the preceding edge was observed to transit than when the passage of the followedge was observed to transi than when the passage of the following edge was noted. It was also subject to a slight variation. Observations by the "eye and ear method" show a tendenty to choose certain tentil of a second in preference to others.—On composite of the configuration of

dp tromotive force, q the quantity of electricity developed and producing a varia ion of volume v, and p the pressure, the juthor has calculated the variations of the electromotive force of different piles, and finds that the results agree extremely well with those arrived at experimentally up to a pressure with those arrived at experimentally up to a pressure of annosphere -A multitubular electric accumulator, by M. D. Tommass —Calculation of the specific heats of liquids, by M. G. Hinnrichs—Melling point of certain binary organic systems, by M. Ló Vigion -Calorimetric researches on the state of sulcum and alternatum in cast-trove, by M. P. O-mond.—Heat of formation of platinic bounds and of its principal compounds, by M. I con Pigion —Contribution to the study of hematic contres, on the hematozonires of the frog, by M Alphonse 1 abbe

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS, PAMPFILET S, and SENTALES RECEIVED STATES.

The Left Remarks of an Algebraic C. W. Perce (Flort a. Cupples).

The Left Remarks of an Algebraic C. W. Perce (Flort a. Cupples).

The Left Remarks of the Left States of Left St

CONTENTS.	PAGE
Rudolf Virchow and his Countrymen Blectric Light Fitting—Good and Bad Work More Suggestions for County Councils The Missouri Botanical Garden, By E. G. B. Our Book Shelf:—	588
Ball "The Story of the Heavens" Martin "Notes on Elementary Physiography" Richardson "Thomas Sopwith, M.A., C E., F.R.S".	589 589
Latters to the Editor:— Electric Transmission of Power.—Joseph John	
Murphy, W. E. A. Rain making.—Dr. Italo Giglioli Weather Cycles and Severe Winters.—A. B. M.	590 590 591
A Lunar Rainbow.—Dr. P. Q. Keegan The Destraction of Mosquitoes.—S. A. M. Law of Pensions.—H. G. Williams The Koh-i-Nur-a Reply.—V. Ball, F.R.S.	. 591 . 591
The KohNur a Reply.—V. Ball, F.R.S. The Nautical Almanac Rain-making in Texas. By Prof George E Curtis Colour-blindoess generally Considered. By T. H.	592 593 594
Bickerton On Van der Waals's Treatment of Laplace's Pressure in the Virial Equation: a Letter to	595
Prof Tait. By Lord Rayleigh, F.R.S	597
Distribution of Lunar Heat . Geologicki Society of America Technical Chemistry. By Prof. R. Meldola, F.R.S.	601
An Astronomer's Work in a Modern Observatory By Dr. David Gill, F.R.S. Societies and Academies Books, Pamphlets, and Sarials Received	. 603 . 608
Books, Pampulets, and Garlais Received	. 000

THURSDAY, OCTOBER 29, 1891.

COPTIC PALÆOGRAPHY

Album de Paléographie Copte pour server à l'Introduction Paléographique des " Actes des Martyrs de l'Erybte" Par Henri Hyvernat (Paris Leroux, 1888)

N all the wide range of subjects connected with archæology, it would perhaps be difficult to find one so little studied as that the name of which stands at the head of this article It is not that it is unimportant, on the contrary, it is most important, it cannot be said to be uninteresting, for the most elementary study of the subject shows it to possess considerable attractions for the philologist, historian, and antiquary The little interest which, until the last few years, has been shown in matters relating to the Coptic language and literature is probably to be attributed to the fact that printed Contic texts are scarce, and that the comparatively few manuscripts which exist are scattered throughout the libraries of Europe.

It will be remembered that in the year 188; M. Hyvernat began to publish the martyrdoms of famous Coptic saints, with a translation in French entitled "Les Actes des Martyrs de l'Égypte"; the Coptic texts were edited chiefly from manuscripts in the Vatican and Borgian Libraries Considerable interest was aroused by his work, and it was hoped that scholars would soon possess accurate copies of the texts of the martyrdoms which form so large a section of the rich collections of Coptic manuscripts at Rome. It may be arrued that the parratives of the sufferings and deaths of Coptic martyrs have much in common, and that a few examples of this class of literature would have been sufficient, but it must be remembered that the historical allusions and incidental remarks. made in them give them a value far beyond their importance as religious documents; while the uncommon words, and unusual forms of the Greek words which their writers borrowed, enrich the Coptic lexicon, and afford material for the student of hieroglyphics who makes a comparative study of the dialects spoken by the Copts and by their ancestors the subjects of the Pharaohs The first volume of the work, in four fasciculi, has appeared, and it is hoped that the second volume, which is promised to contain a critical introduction, &c , will not be long delayed

Meanwhile, however, M. Hyvernat has given us his "Palæographic Album," and it is to this important publication that we must now give our attention; the scientific plan which he has followed in setting before scholars facts and nothing but facts, and his systematic arrangement of them, make his work most welcome The first Coptic scholar who gave his attention to the subject of Coptic palæography was Zoega, the Dane, and in his famous "Catalogus Codicum Copticorum," published (after his death) at Rome in 1810, are given seven plates containing specimens of the writing found in Coptic manuscripts of various periods; since that time facsimile specimens of important manuscripts have been published, as, for example, a page of the famous Gnostic work, "Pistis Sophia," in the "Facsimiles of Ancient Manuscripts, &c.," issued by the Palæographical Society (Oriental Series, plate 42, 1878).

The work before us contains fifty-seven large folio plates, upon which are reproduced by photography about one hundred examples of Contic writing: the execution of these plates is perfect, and M. Hyvernat has shown great knowledge and judgment in making the selection The original manuscripts are preserved in Rome, Milan, Turin, Naples, Paris, London, and Oxford, and the time and labour spent by him in reading and examining them must have been very considerable. The manuscriptsthat is, books made of parchment and paper, for M Hyvernat excludes inscriptions upon stones, and papyri, whether contracts or otherwise-belong to all periods; the earliest cannot be later than the sixth century A D . and the latest dates from the last century We have thus for palæographical investigation a field of not less than twelve hundred years

The specimens of the writings anterior to the ninth century have been taken from manuscripts which are, by the common consent of the best authorities, admitted to belong to this period, all those after the ninth century are taken from dated manuscripts, and thus there is no doubt possible as to their age. The wisdom of this plan is evident, for, in the case of uncial writing, the character of which practically remained unchanged among the Copts for centuries, it is almost impossible to assign an exact date to a manuscript unless a dated standard is forthcoming Coptic manuscripts which are to be attributed to the sixth or seventh century are rare, and as examples of them M. Hyvernat has selected the Gnostic treatise called "Pistis Sophia"1 (Brit. Mus , No 5114) and the life of St Pachomius, 2 the pages are small quarto in size, with two columns of writing to the page, and ornamentation is rare. In the seventh and eighth centuries the writing becomes firmer and bolder, the pages are larger, and the sides of the columns are ornamented with graceful designs and birds (doves?). The picture of Job and his three daughters (PI 5), wearing Byzantine costumes and ornaments, is very instructive Pl 6 gives a leaf from a palimpsest manuscript, inscribed in Coptic with verses from the Old Testament, and in Syriac with the martyrdom of St Peter of Alexandiia

Of the tenth and eleventh centuries we have fine specimens of manuscripts containing homilies, canons, sermons, martyrdoms, &c , the pages are large, the writing, in two columns, is bold and handsome, the initial letters of paragraphs are large, and stand away from the columns, which are often profusely decorated with birds, flowers, ornaments in the shape of vases, &c last pages of works of this period often contain portraits of those who are referred to in them, and the larger manuscripts have full-page illustrations of the subjectmaiter; as, for example, Theodore the General overthrowing the dragon and rescuing the widow's children (Pl 16), St Mercurius destroying Julian the Apostate (Pl 17), and "Moses the Prophet" standing with bare feet by the side of the burning bush (Pl. 19). On Pls 14, 21, and 32 are some interesting examples of Coptic cryptography and cursive writing. At the end of the tenth century the first page of each work in a manuscript is ornamented with deep borders of tracery and interlacing

The test, with Latin translation, was published by Schwarze at Berlin in 1851

The text, with French translation, was published by Amélineau, "His tours de Saint Pakhlime" (Paris, 1880) in various colours, and the initial letters are very large (Pls. 34, 38)

A fine example of the writing and illumination of the thirteenth century is that given on Pl. I, from a Coptic and Arabic Evangelarium written A.D 1250, in it St. Mark, seated, is about to receive in a napkin the book of the Gospels from St. Peter, and by his side is a stand in the shape of that used to hold a Koran : opposite is a scene in which John the Baptist is baptizing Christ in the lordan, in the presence of two angels, who hold napkins, and above them is descending from blue heavens the Holy Ghost in the form of a dove Behind John the Baptist is a tree, in the trunk of which an axe has been struck. Of illustrated Gospels of this period we have excellent specimens on Pls 44-47, where the Transfiguration, the devils entering the swine, the Marriage at Cana, the Last Supper, the Crucifixion, &c, display a quaint mixture of ancient Coptic, Byzantine, and Arab methods of illumination and ornamentation. Of manuscripts of the thirteenth and fourteenth centuries good examples are given on Pls. 50 foll, with facsimiles of the elaborate crosses of the period and of the portraits of the four Evangelists in circles. The space at our disposal will not allow a more detailed description of the contents of the "Album de Palcographie Copte" than that given above, which will serve to indicate the great value of the work to scholars

The Copts, or "Egyptian" Christians, played no unimportant part in the history of Egypt after the preaching of St Mark at Alexandria, AD 64, and from that time until the present day they have steadily and consistently maintained their religious opinions without change. They clung fast to their language, in spite of the widespread use of Greek in Egypt in the earlier centuries of this era , and although they adopted the Greek alphabet, with the addition of some few signs from the demotic, and borrowed largely from the Greek vocabulary, they did not cease to write their books in Coptic nor to celebrate the services of their Church in that language After the conquest of Egypt by the Arabs, the Copts held positions of dignity and importance there for some hundreds of years, but about the twelfth century they seem to have fallen into poverty and contempt, and about a century later it seems that they ceased to produce literary works; moreover, the growing custom of adding Arabic translations by the side of the Copuc texts proves that the knowledge of Coptic was dying out. During the next few centuries it probably became the study of the learned. In the course of the last two centuries, travellers in the East have brought to Europe numbers of Coptic manuscripts, and among those deserving special mention are Pietro della Valle, and Huntingdon, Assemani, Curzon and Tattam. The revival of Copiic learning was begun by Abela, a Makese, and his work was carried on by kircher, Petræus, Jablonski, Renaudot, Wilkins, Vansleb, Lacroze, Tuki, George, Zoega, Quatremère, Tattam, and Peyron, among those who have done much excellent work in Coptic during the present century are Schwartze, Lagarde, Revillout, and Ruckert. The recent works of Amélineau and Hyvernat show that serious attention is now being paid to the Coptic language for philological and ecclesiastical purposes, and that the publication of new material is going on rapidly

In conclusion, all lovers of Copius hterature one a debt of gratude to M. Henri Hignard, formerly President of the Academie de Lyon, for his hiberality in undertaking the expense of publishing this work, and to M Hyvernat for the excellent way in which he has made use of the funds so generously placed at his disposal

BRITISH MUSEUM (NATURAL HISTORY) CATALOGUES.

Systematic List of the Frederick E. Edwards Collection of Britath Ologeone and Excess Molluca in the British Museum (Natural History), with Reference to the Type Speamens from similar Horizons contained in other Collections belonging to the Geological Department of the Museum By Richard Bullen Newton, FG S Pp. xviii and 563, with a large Folding Table (London Printed by order of the Trustees Soid by Longmans and Co; Quartich; Dulau and Co; Kegan Paul, Trench, Trubner, and Co, and at the Natural History Museum 1891)

THE interest which attaches to the records of past periods of our earth's history is greatly enhanced when we find them in the strata forming the very ground beneath our feet. Such is the explanation of the origin of the well-known Edwards Collection of Eocene Mollusca, which forms the subject of the volume before us. Mr Frederick Edwards resided at Hampstead some fifty years ago, at a time when the Primrose Hill tunnel of the London and North-Western Railway was formed. and the Archway Road, Highgate, had lately been cut. and, later still, the Great Northern tunnel under Copenhagen Fields These, and many brick-field excavations in the north of London, led to the discovery of abundant fossil-remains around his residence, and attracted the attention not only of Mr. Edwards, but of Dr Bowerbank. Mr Wetherell, Prof. John Morris, Mr Searles V. Wood and his son, Mr Sowerby, Mr. White, Mr Page, and other geologists living in Highbury, Highgate, Hampstead, and Kentish Town, who formed among themselves a small Naturalists' Society, known as the "London Clay Club," the members of which met periodically at each other's houses, to compare and exchange specimens. and to name the fossils they had discovered in the London clay Mr Wetherell, Dr Bowerbank, and Mr. Frederick Edwards made most extensive collections; but, whilst Wetherell and Bowerbank collected from the London Clay, the Chalk, and other formations, Mr. Frederick Edwards devoted all his attention to the Mollusca of the London Clay and other Tertiary beds of the south-east of England. All his summer holidays were spent in such spots as the New Forest (where, at Brockenhurst, Bramshaw, Lyndhurst, and many other spots, assisted by Mr. Henry Keeping, he opened numerous trial-pits), or at Barton and Hordwell on the coast of Hampshire, Colwell Bay, Headon Hill, Osborne, Hempsted, Bembridge in the Isle of Wight, and Bracklesham Bay, Sussex. He collected at all these places, and carefully recorded the localities from whence his specimens were derived. With infinite care he mounted and named these delicate Tertiary shells, and the beautiful specimens. so prepared have been preserved in their entirety in the National Museum.

After the formation of the Palzeontographical Society, a large number of Mr. Edwards's Mollusca were monographed by him from 1849 to 1850 (five parts), and continued by S. V. Wood, 1851 to 1879, (four parts) appears were published in the London Geological Journal, the Geological Society of London University of the Geological Society of London University of London 1840 (London 1840).

The unpublished labour which Mr. Edwards expended on his cabinets greatly exceeded that which he devoted to the publication of a part of their contents, as may readily be seen by a study of his collection; and when it is known that this work was all performed in the lessure hours of a busylife as a Master-in-Chancery, hearing and deciding law cases in Chambers all day, one is astonished to find how much he was able to accomplish.

The collection contains no fewer than 39,191 specimens, referred to 1805 species of Mollusca, divided into the following classes:—

Of this number 585 are manuscript species, proposed by F. E. Edwards, which have not yet been described, so that nearly one-third has to be deducted from the above total if we would arrive at the actual number of species already figured and described.

It may be objected that these manuscript names ought not to have been printed, but Mr. Newton points out, in the preface to bus catalogue, that these have got into circulation abroad in hists published by German and French palesontologists, with whom Mr. Edwards had corresponded, until, hise some paper-currences, hey have obtained for themselves an artificial value, and it would be inconvenient to omit to mention them in a list of Mr. Edward's own collection. Mr. Newton, moreover, promises shortly to describe and figure them, thus giving them their full **ginate-value**, a promise which we sincerely trust he will find lesiure to perform.

In addition to the specimens in F. E. Edwards's own collection, figured and described by himself and others, all those in the Brander, Sowerby, Dison, Bowerbank, and Wetherell collections are duly recorded; so that much valuable information as to the whereabouts of these types, and references to the works in which they are recorded, has been carefully brought together in this volume by Mr Newton.

Apart from the vast variety, as well as the rare beauty of form, by which the Mollusco of the Eocene period at once arrest the attention of even the most unlearned, to the student of palezontology they afford unmustabable evidence of the existence in this sarliest Tertiary period of subtropical marine conditions over this portion of the earth's surface, which now forms South-eastern England. Several extinct forms of Nautilus and Cuttlefishes, associated with huge species of Certifising. Cowries, Cones, Voluces, and such genera as Rottellaria, Mitray, Cones, Voluces, and such genera as Rottellaria, Mitray, Margiulala, Cancellaria, Oliva, Ouula, and Srephi,

with Terebra, Pirinia, Phorus, Solarium, Nersta, and Chaton, make up a rich display of Mollusca belonging to the warmer seas of the globe, and if we add such genera as Pholadomya, Spondylus, Crassatella, and many of the other bivalves, they tell the same tale Crustacea, Echinodermata, and Corals were also present, together with numerous Turtles, whilst along the shores of the rivers huge Crocodiles patiently awaited the Palantheria and Anoblotheria from the neighbouring lands. Terrestrial vegetation, washed down from the Eocene continent, also proves to be of a tropical kind -- Palms, Cacti, Dryandra, Maple, Azalea, Acacias, with others, belonging to more temperate latitudes, forming a part of the vegetation of our island to day. Nor were the terrestrial Mollusca unaffected by the increased temperature, for we find large Bulimi and Helices unlike those now living in this country, whilst the species of Ismnea and Planorbis were both large and very abundant, and were associated with Potamides, Mclama, and other exotic genera in its streams. That there must have been at that time a close connection between our English Eocene area and the much larger Eocene area of France, cannot be doubted, for the beds of the l'aris basin and those of Hampshire and London are capable of close correlation, and many genera and species are common to both areas.

Mr. Newton has fortunately obtained the co-operation of Mr. George F. Harris, who has, in an appendix added some valuable tables, showing the probable equivalent horizons of our several English Tertiary beds with those on the Continent, in France, lielgium, and Germany, and as far east a Austria and Italy, and southwards to Spain. These tables will prove of the greatest value to the student who seeks to understand, and even to map out, the former geographical extent of the several successive Territary deposits of Europe, with their varied land, freshwater, and marine records of past life, both animal and vegetable

Most of the points dealt with by Mr Newton in the introduction to his list have reference to questions of priority in names, and explanatory notes in justification of some which have been abolished-either because the name had been pre-occupied for a genus of fishes, or buds, or reptiles, &c., or because it had been discovered that another author had previously described the same shell, and had at an earlier date given it another name Many old favourites have thus been relegated to obscurity, whilst fresh names, dug up from some forgotten corner. have, by the law of priority, taken their places. Thus -Meretrix, Lamarck, 1799, takes the place of his better known Cytherea of 1806, the latter having been applied by Fabricius, in 1805, to a dipterous insect. Triton, De Montfort, 1810, gives place to Lampusia, Schumacher, 1817, "having been applied by Linnæus to a Cirripede in 1767." But as no genus of Cirripedes is known by that name at present, this is a needless and undesirable alteration, especially as Mr. Newton remarks, "the genus Traton still continues a favourite name among conchologists"; we would add, "long may it continue" so Darwin says: "I cannot doubt that the Trilon described by Linnæus was only the exuvia of some Ralames (probably B. portatus), Linnæus mistaking the proboscidiformed penis for the mouth of his imagined

distinct animal" (Darwin's Balani la, Ray Soc., 1854, p. 158)

It would be an immense gain if every name proposed to be altered had to pass through a regularly-constituted committee of investigation before it was accepted and allowed to pass current. As it is, endless confusion must arise, and needless alterations will for ever be made, serving no good end to science.

Mr R B Newon's systematic list of the Eocean and Oligocean Molliusca of our British strata will prove extremely valuable to all those who take an interest in our Tertiary deposits and their contained organisms. Every curator of a paleontological collection must have it, as a work of reference, by his side, as, for this section of fossils, it takes the place of "Morris's Catalogue," now long out of date We shall be very glad to see other sections treated in a similar manner—indeed, Messrs -A. Smith Woodward and C D. Sherborm have already catalogued the fossil Vertebrata of the British Isles in 1890, and the work has been published by Dulau and Co.

THE LIFE AND WORK OF A NORFOLK GLOLOGIST.

Memorials of John Gunn being some Account of the Cromer Forest Bed and its Fossi Mammalia Edited by H B Woodward and E T Newton Pp xi, 120; 13 Plates (Portrait and Fossil Mammalia) (Norwich: W A Nudd, 1861)

ALL students of the geology of the eastern and central parts of Norfolk and Suffolk will welcome this book, as giving the well-matured opinions of a geologist whose life work was chiefly concerned with the Forest Bed and its associated formations, Crag and Drift Those too who knew Mr Gunn must be glad to have this memorial of so courteous, kindly, truth-seeking a man. No one enjoyed his friendship but was the better for it, and the writer looks back on days spent in his company, both in the field and at meetings of the Norwich Geological Society, as amongst the happiest events of a long sojourn in the Eastern Counties. Until reading this book he did not know the politics of Mr. (runn, and he is glad to find another of many instances in which such matters are kept in the background, as regards scientific intercourse and personal friendship.

To those who, like the writer, are not greatly enamoured with biography and its multiplicity of personal details it is satisfactory to find this part of the book artistically treated, by Mr. Woodward, in only 27 pages, which are full of interest. The best memorial of a scientific man is the work that he has done and by which he will be known in the time to come, and it is to Mr. Gunn's work that the editors chefly direct our attention. After, the many contractions of the contraction of the contraction

For the task of bringing these matters before the public no better editors could have been chosen. One of them, who, in his Geological Survey work, was brought much in contact with Mr Gunn, may be called the hereditary geologist of Norfolk. The other has for some years

given great attention to the study of the fossil Mammalia of the Forest Bed, and indeed has made himself the chief authority on the subject.

In 1864, Mr Gunn helped to found the Norwich Geological Society, of which he was the first and the last Plesident, returing from that post only for six years. (1877–83) in order that it should be filled by officers of the Geological Survey who were stationed in Norfolk and Suffolk a graceful compliment. He was also one of the founders of the Norfolk Archeological Society, and an active member of the Norwich Science Gossi Citub, and a member of the Norwich Science Gossi Citub, and a member of the Norwich Museum, which he enriched by his fine collection of fossil mammark.

Now that coal has been found underground at Dover, and that there may be some chance of a search for it being made in the Eastern Counties, it should be remembered that Mr Gunn was the first to advocate that-work in Norfolk

On the ground that "unanimity does not prevail in regard to the nomenclature of the strate "of the Strafe (cliffs, Mr. Woodward gives a useful table, on p. 60. showing the classifications of Guinn, of Presitiveth, and of C. Keid, but that of Wood might have been added with advantage, and he draws attention to the fact that the cliffs are cut back greatly year by year, so that earlier observers may have seen something different from later ones. As the loss of coast is still going on, and the Forest Bed seems not to reach far inland, a happy time may come when that Series will cease to furnish any ground for contention in this matter the geologists of the future may have to take the work of their foregoers, without the luxury of upsetting it.

In his account of the Forest Bed Series, Mr Gunn holds to the view that, as a rule, the trees given on the spots where the stumps are now found. He describes firstly the Estamane Soil, then the Forest Bed proper, then the Reconstructed Forest Bed (a division not historie recognized, and hardly likely to be, reconstruction seeming to occur in various parts of the Series) and lastly the Unio and Rootles Bed; but it should be noted that other observers take the Forest Bed and the Rootles Bed to be one. His use of the term Lammated Beds, for the immediate successor of the Forest Bed Series, is unfortunate, as such names usually are, for lammation is common in the Chillesford Chy below and in some of the Glacial Drift above.

Mr Gunn's notes conclude with remarks, in some detail, on the Proboscides of the Norwich Crag and of the Forest Bed Series, and on the Cervidæ of the latter, chiefly based, with the plates, on the specimens which so liberally gave to the Norwich Museum. The notes are followed by a list of his geological and archaeological papers, ranging over forty-eight years, from 184 bot 1857.

The plates of Mammalian fossils are well executed; but it is a pity that those of Proboscidea and those of Cervidic are not numbered consecutively, instead of independently. The portrait that forms the frontispiece is a good one, and the book is well printed.

Few geologists can expect their names to be handed down to posterity by so fine a set of specimens as those of the Gunn Collection in the Norwich Museum, and by so interesting a literary accompaniment as that now noticed.

OUR BOOK SHELF.

The Melanesians: Studies in their Anthropology and Folk Press. 1891)

IN this book Dr. Codrington gives us the results of observations and inquiries made in the Melanesian Islands from 1863, when he first visited them, to 1887, when he left the Melanesian Mission He does not profess to He does not profess to offer a complete account of the Melanesian people, nevertheless, the work is one of great value, for it is in the main a record, not of what I uropeans say about the natives, but of what the natives say about themselves The most careful of European inquirers may, of course, mistake the real significance of what natives tell them, but Dr Codrington seems to have been at all times fully conscious of this danger, and to have done his best to guard against it

He begins with a chapter on the discovery of the Melanesian Islands, and on their geology and zoology The ethnology of Melanesia he does not attempt to deal with, but he discusses thoroughly the facts relating to kinship and marriage connection among the Melanesians, starting with the proposition that the division of the people into two or more classes, which are exogamous, and in which descent is traced through the mither, is the foundation of native society. He also gives a good account of the position of the chiefs. A chapter is devoted to property and inheritance, and this is followed by a description of secret societies and clubs, a knowledge of both of which is essential to a proper comprehension

of Melanesian life

The religion of the Melanesians, like that of all savage and barbarous peoples, is a subject of great difficulty, but Dr Codrington is able to present clearly what seem to be at least its main outlines. Students of the evolution of religious conceptions will read with especial interest what he has to say about "mana," a supernatural power or influence which is supposed to act in all kinds of ways for good and evil, and which everyone tries to possess or control. The objects of worship are spirits, some of which were formerly men, while others belong to an inde-pendent and higher class All these beings are full of pendent and higher class mana," and many suggestive facts about the popular belief in them will be found in the chapters on sacrifices, prayers, spirits, sacred places and things, magic, possession, and intercourse with ghosis There are also good chapters on birth, childhood, and marriage, death, burial, and "after death."

The chapters on the arts of life, and on dances, music, and games, contain an immense number of interesting facts, well arranged, and in a chapter entitled "Miscellaneous," the author treats of several disconnected subjects, such as cannibalism, head taking, and castaways The concluding chapter is in some respects the best of all. It consists of stories, divided into three groups—animal stories, myths and tales of origins, and wonder These stories are not only pleasant to read, but provide excellent materials for those who devote themselves to the comparative study of folk-tales.

We may note that there are some very good illustrations, especially in the chapter on the arts of life.

Guide to Examinations in Physiography, and Answers 10 Questions By W Jerome Harrison, F G S. (London Blackie and Son, 1891)

THE author of this little work of forty-eight pages is well known as a successful teacher, of wide experience in connection with classes recognized by the Science and Art Department. It is sowedly a guide to the art of passing an examination, the author giving it as his opinion that "knowledge of any subject is not the only requisite to successfully passing an examination in it."

Unfortunately, this is, to a certain extent, true Some candidates are upt to make an injudicious choice of questions, while others, again, spend too little time in studying them, and consequently wander from the point Few who read Mr Harrison's notes will fail to profit by the sound advice which he gives

The first part gives general information about the Science and Art Department and its objects, and applies equally to all the subjects in which its exami-nations are held. The questions which have been given in the elemen y stage since 1882 are answered in

the examiners

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions ex-pressed by his correspondents. Nisther can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE No notice is taken of anonymous communications!

A Difficulty in Weismannism

WEISMANN'S theories of heredity and sexual reproduction have been criticized from many a friest points of view. The following remarks are an attempt to apply to his theory of reprofollowing remarks are an attempt to appry to an and assuming its duction a test familiar to the mathematician, and assuming its truth, to follow out the deductions from this assumption. The result is a startling one. I believe the following theses will be accepted as an impartial statement of the main points of the

accepted as an imperation of the form of the form of the form of ancestral germ units, the Ahnenplasmas, and this number is constant, for the species at least.

If These ancestral germ-units are far more constant and un-changeable in character than the species itself.

changeable in character than the species useff.

III They lie associated together in the germ cell without loss or alteration of their neidwidsal personalities.

IV The number commends and the constraint of the Athendraint of the or packs of cards by taking that from each and poung the lathour or renundents to lorm a new constraint of the constraint of

V. The possible combinations under this process are so numerous as to explain the variations among the offspring of sexual

Accepting these statements, we next inquire, How are we to conceive of these ancestral units, the Ahnenplasmas? Two hypotheses may be given in answer to this question !--A Each Ahnenplasma unit corresponds to an individual of

"A Each Ahnenplasma want corresponds to an individual of the speces itself, and if put ander proper trophec conditions would, amply, reproduce such an individual would, amply, reproduce such an individual consideration of the produce such an individual consideration of the produce modification of the case of the produce modifications due to external essues (sequired modifications) According to hypothesia A, the Ahnenplasma of living, and so we get Protechouldie, and finally Protometissua and so we get Protechouldie, and finally Protometissua Ahnenplasmas in the gern cells for one more and more remote anecessor. In other words, the Ahnenplasma have warrel is more toolly renders the shuffling process unnecessary to evolution to only renders the shuffling process unnecessary to evolution.

actionately, and at the sum 'are with the suc. This inference ont only renders the shelling process unnecessity to explain variation, but it is inconsistent with these II., the very foundation of Wessmann is theory of heredit with the sum of the sum of

"Hereditary variability can only arise in the lowest unreello organisms; and necessarily passed over into the higher organi when they first appeared" (Weismann, "On Heredity." English edit p 299). The passage would seem to render hyp thesis "necessity for

NO. 1148, VOI. 447

number of Ahnenplasmas varies from species to species; (2) that the number in the combination and not the character of the Ahnenplasmas determines the species. And as there is not a on hypothesis B the theory breaks down by its non-conformity with the facts

We have then the dilemma, from which I see no escape, that the theory is inconsistent, on A with itself, on B with the facts When once worked out and fairly put into words, which was not so casy as it may appear, this argument seemed so obvious that I felt sure it must have been long since urged, confuted, and dismissed. But not having found any reference to it, I now state it fully, in the hope that the question mised may be thoroughly MARCHE HARTOG discussed

Dublin, October 12

Rain-making Experiments

YOUR last number contains an article by Prof Curtis on the "rain-making" experiments in Texas, in which no reference is made to the report published in the October number of the North unale to the report published in the October number of the Norial Austraca Kiraw by General Dyreaforth, who directed the operations. I wish to call altention to the remarkable difference which easist between the statements of Prol Curus, the meteorologist of the expedition, and General Dyreaforth, its director countries of the expedition, and General Dyreaforth is director even of the traperments, believes that only thangy howers or "good grass rain" fell. General Dyreaforth says the amount was nearly a Inches. On August 18, Prof Curus sus pathat only 0.02 inch of rain fell; General Dyreaforth says that will dreach a manifell in Ceneral Dyreaforth says the amount arise fill in toreas for two and a faith fours," and that driving from the excampment to Midland, a dutance of a 3 miles, of water. It is a minosable, under these circumstances for those road traversed was covered for \$6 or \$8 miles under \$4\$ to \$6 miles of water. It is impossible, under these cromustances, for those of water and the impossible that these cross the same and the same a is evident that the explosions of hydrogen and oxygen, on wincome General Dyrenforth relies so much, are useless, and that the smoke-producing rackatock does all the work. In an extremely sceptical and very justly cruical article, which follows that of General Dyrenforth in the North American Review. that of General Dyrenforth in the North American Revenue, Prof. Simon Newcomb, while scouting the "concussion" theories of General Dyrenforth, says, indeed, that smoke particles may possibly serve as nuclei for the condensation of water vapour, but he is evidently unacquainted with the re-markalite work of Mr. Autken, which throws so much light on the matter

Manchester, October 24.

A Rare Phenomenon.

HAVING just returned from Norway, it may be of interest to record inhat the hand of light which was observed by many of your correspondents on September 11, was remarkably williast in N lat, 52°, extending from the horison to the zenith, but not beyond. It was nearly, but not quite, equal in width throughout the 50°, and therefore must either have been much wider at the base than at the speez, or else at an immense alti-Some clue to the estimation of this altitude would be afforded by an accurate record of the zenith distance as observed in Lingland.

I may add that the aurora borealis was distinctly visible in the north and north west at the same time, but this band rose from north and north west at the same time, but this band rose from the tonth-east, which ied me to conjecture that it might belong to a comet; however, on the following night it did not recur, and it then thought it might have been caused by some san-hit cirra at a great elevation, but it is now obvious that this was not the case. The remarkable feature was its concurrence with, and yet apparent difference from, the ordinary autora. Richmood, Surrey, October 24. W. DUPFA-CROTKA.

THE phenomenon obserged by Dr. Copeland (NATURE, September 24, p 494) at 11.18 pm. on September 10 at Dunccht, by Mr. W. E. Wilson at 9 pm. on September 11 m Co. Westmeath, and by other observers on the 11th in

NO. 1148, VOL. 44]

several parts of England, was observed by a party of three, including myself, at 9 30 p.m. on September 25 at Ballater, Aberdeenshire.

nergeensnire.
It appeared as an inten-e white beam of light stretchin. It appeared as an interie white beam of light stretching from east to seat and directly overhead, of uniform width and perfectly steady II exemed quite low down, almost as if it might light up the summit of the church spire were it moved a little further towards the south At III.30 the light had become diffuse, and it appeared at a much greater elevation, though maintaining its general direction from east to west.

W.N. HARTEN.

October 22

Earthquake at Bournemouth

Wa had a sharp momentary shock of earthquake here at four o'clock this afternoon. I happened to have my eyes fixed on a plant with long variegated leaves on my dining-room table. Suddenly there was a heavy sound as of some subterranean fall, and simultaneously the leaves of this plant were violently agiand simultaneously the leaves of this plant were violently agi-lated—waved up and down—for some seconds. It was as if it lad risen vertically and then failen It was wholly unmoved by so much as a tremor the rest of the afternoon. I tred to reproduce anything like the same disturbance by band, but with out success.

Bregner, Bournemouth, October 25.

W = M_s

I had read Mr Slate's letter (Nature, vol. xliv p. 445), and admired R, moreover, I found myself in agreement with him. But it seems to me strange that Prof. Greenfull should approve of R. For Mr Slate takes as his gravitational unit of him. But it seems to me strange that Prof. Greenhill should approve of it. For Mr Slate takes as his gravitational unit of force "the swagest of one pound under cravastiances specified with the thorsity of the swagest of one pound under cravastiances specified with the three sizes (Prof. Greenhill's food) when they say that "the weight of a given body depends on the local value of \(\frac{t}{2} \). Prof. Greenhill's on the contrary, speaking of goods, any that (Prof. Greenhill's and the prof. (BAFURLYO) six possible speaking of goods, any that (BAFURLYO) six possible speaking to good the prof. (BAFURLYO) six possible speaking the speaking the prof. (BAFURLYO) six possible speaking the speaking t

and sub-multiples. Hence the every-day, slightly ambiguous, use of the word "weight" in matters in which we are not concerned with mertia. But in the science of dynamics, of which Newton's with inertia. But in the science of dynamics, of with Newton's laws are the foundation, we are concerned printerly with the well-known lump of pistunum as the standard pound, the British sunt of mass. They thus have the word "weight" for, and any (ε, χ) that the weight of the standard pound is measured by the standard pound in measured by the standard pound on the bottom of the standard pressure that it can ref (in vacco) on the bottom of the risultant pressure that it exerts (in watco) on see some of very the visit and first. It requires more than general expressions of condemnation to show that say other system of nonenculatures as clearer or less free from ambiguary, or that the egastion W = Mg has not as much mening as any other dynamical equation. (I may refer back to my letter, NATUER, vol. xiv. ADD.

p. 493). Devonport, September 26.

SOME NOTES ON THE FRANKFORT INTER-NATIONAL ELECTRICAL EXHIBITION!

Alternate Current Motors.

A LTERNATE current motors constitute one of the most striking features at the Frankfort Exhibition, and the commercial use of such motors will probably date from this year, so that the one great objection to the endogram of the commercial use of the commercial to the electric transmission and distribution of power will soon dis-

appear.

It is well known that the direction of rotation of an ordinary series, or shunt, direct current motor is the same whichever was the direct current motor is the same whichever was the direct current passes round the motor, in spite of a patent of Mr. Edison's to utilize the contrary fact on electric railways, hence it follows that if an alternate current be sent round such a motor it will start rotating and develop mechanical power. Only a com-

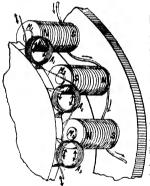


Fig 10 -Alternate current synchronizing motor -> Alternating current

paratively small power and efficiency, however, will be obtained: first, because the large self-undurion of the field magnet of the motor will seriously diminush the strength of the alternating current; secondly, because, in consequence of the rapid reversals of the magnetism, much power will be wasted in heating the iron core of the field magnet, even although this core be laminated like that of the armature.

He can to the armature. If, on the other hand, a direct current be sent round the field magnet, M_1 , M_2 , M_3 , of an alternate current machine, and an alternating current rough the armature, A_1 , A_2 , A_3 , A_4 , (Fig 10), the armature will not move, because at every two of the successive rapid reversals of the current the armature receives an impulse in opposite directions. To enable such a machine to work as a monor.

Continued from p 546.

NO. 1148, VOL. 441

It is necessary to first make the armatuse rapidly rotate by mechanical means at such a speed that any armature coil, A., mores forward by the distance being any armature coil, A., mores forward by the distance being armature coil, A., mores forward by the distance being at the periodic time of the alternation of the current. When this speed has been once attained, the machine will go or numing as a powerful and efficient alternate current motor, at a percety definite speed, dejending simply on the rate of alternation of the current, and independent within wide limits of the load put on the motor.

So that when the armature of the motor is once "in step" with that of the dynamo the two will continue "in step," whatever be the amount, within wide limits, of the power transmitted

When a considerable amount of power has to be sent from a source to a distant town, and has there to be distributed for light or for driving machinery, it will certainly be best (as far as our present knowledge goes) to use alternating currents in the transmission of the power between the two distant places, because with alternating currents the pressure can so easily be transmissing currents the pressure can so easily be transmissing currents the pressure can so easily be transmission.

But in the distribution of the received power direct currents are the more convenient, since they can be utilized for light, for electroplating and electrotyping,

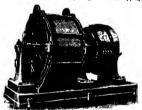


Fig. 11 -Coupled alternate current meter an intentiture it dynamo

as well as for small and large duert current electromotors, both of which have already eached a considerable degree of perfection, and are of course selfstarting. Hence it is probable that there will be imployed a synchronizing alternate current motor, coupled mechanically to a direct current dynamo, the latter being used to supply current to the town and excite the field magnets of the motor. Such combinations, seen in Fig. 11, are exhibited by Messra Steinens and Halske in the Irankfort Exhibition, the alternate current motor being to the left and the direct current of the properties of the left and the direct current of the properties of the left and the direct current of the properties of the left and the direct current of the properties of the left and the direct current of the properties of the latter and the properties of the prope

In the particular form of direct current dynamo shown in Fig. 11, and which represents a type much used now on the Continent, the field magnets are inside the rotating armature, and the wires on the outside of the Gramme ring itself are bare, and act as the commutator.

The impossibility of starting the simple synchronizing motor with an alternating current will be of little consecutions.

The impossibility of starting the simple synchronizing motor with an alternating current will be of little consequence when a large amount of power has to be transmitted, seeing that in the receiving station there will be several sets of generic alternate current motors and direct current dynamos, some of which will be always rouning day and night. Hence, to start any alternate current motor, all that need be done will be to send round the direct current

dynamo, attached to the motor to be started, a portion of the direct current that is being produced by one of the running dynamos. This will cause the stationary direct running dynamos. Inis will cause the stationary direct current dynamo to start running as a motor, and when the right speed has been attained—that is, when the motor is in step with the distant alternate current dynamo—the alternate current can be switched on to the alternate current motor

Actual plans are being seriously got out at the present time, for using this exact method to transmit 5000 horsepower over forty miles in Tasmania, the received power being transformed by ten such combinations as are seen

in Fig 11, each of 500 horse power.

This subdivision of the machinery at the receiving generating plant at the sending end of the line, will have another most important advantage, viz that a breakdown of a dynamo or of a motor will not cause a stoppage in the supply of power. A factory 15, no doubt, worked at present with a single large engine; the propulsion of a steamer depends on the turning of a single powerful screw, but neither the unexpected stoppage of the factory engine for say half-an-hour once every two or three months, nor the delay of an Atlantic liner in mid-ocean for the same time once in every half-dozen voyages, would necessarily mean run Were, however, the 10,000 horse power dynamo at Deptford to be ever finished and worked at its full output, it would be necessary, in order to avoid a temporary hitch leading to the turning off the current from many thousands of glow lamps, and the plunging of a neighbourhood into darkness, to always have dynamos of a capacity of 10,000 horsepower kept idle in reserve

Experience has shown that the size of each dynamo in a maximum output, and that it is sufficient to keep one, or at the most two such dynamos, as a reserve, to prevent temporary breakdowns interfering with the steady is lighting some 500,000 glow lamps or more than ten times the total number at present attached to the mains of the London Electric Supply Corporation—no one but the Brunel of electricity would have had the courage to embark on a 10,000 horse-power machine

At any rate, when during the next year or two it is required to transmit a large amount of power over a considerable distance, it is probable that several alternate current synchronizing motors, each coupled to a direct current dynamo, will be employed at the receiving end of

the line

In cases, however, where there already exists an extended system of distributing alternate currents for electric light, the introduction of motors into small workshops and private houses will hardly be possible, unless the motors can be made self-starting Mr Zipernowski's motors, employed for driving the tools in a curpenter's shop at the Frankfort Exhibition, have been made selfstarting, and also fairly efficient, by adopting a compromise between the simple direct current motor, which is self-starting but inefficient when used with alternating currents, and the alternate current synchronizing motor, which is efficient but not self-starting.

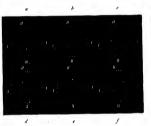
The device employed by Mr Zipernowski, and which is based on a communication made by Prof. G Forbes to the Royal Society of Edinburgh some eight years ago, is as follows: -- Send the alternating current round the field magnet as well as round the armature of an alternate current motor (Fig 10), and attach a commutator to the armature so as to reverse the current flowing round the field magnet every time the armature coils A₁, A₂, A₃ pass the field magnet coils M₁, M₂, M₃ On sending the alternate current round such a motor, the motor will start, but since at first the rapidity of alternation of the current will be far greater than the rapidity of commutation there cates the position which in each case would be taken up

will be much sparking at the commutator and waste of power As, however, the armature turns more and more quickly, the commutation will be effected more more query, the commutation will be effected more and more rapidly, until at last the armature will attain such a speed that every time the current is reversed by the distant dynamo the portion of the current flowing round the field magnet of the motor will be commutated by the rapidly rotating armature. Hence the current flowing round this field magnet will now be always in the same direction. But as it will not be always of the same strength there will be more waste of power than with a simple synchronizing motor

Such an arrangement as that adopted by Mr. Zipernowski, then, furnishes a motor which, although not as efficient and powerful for its weight as the synchronizing motor previously described, has the advantage of synchronizing fairly well, of being self-starting, and of giving far betterresults than a direct current motor with laminated field magnets used with alternating currents.

It is possible, however, as proved by Prof Ferraris in

1885, to design an alternate current motor on totally different principles, and to construct a machine which will work not merely without a commutator, but without even any sort of rubbing contact So that, in fact, the



Fit 12 -Rotating magnetic field produced by two alternating currents

ends of all the wires on a Ferraris motor may be per-manently soldered, and the motor left in the hands of a person who knows how to oil a machine but who is quite ignorant of the trimming and adjustment of the brushes of an ordinary direct current motor

Round an iron ring are wound four coils, as seen in Fig. 12, and through the two distinct circuits are sent two harmonic alternating currents having the same periodic time and maximum amptitude, but differing by 90° in phase. The ring will therefore receive two magnetizations along two fixed diameters at right angles to one another, the two magnetizations alternating approximately according to the sine function of the time, and differing by 90° in phase. And the composition of these two magnetizations will give a "rotating magnetic field," which will make one complete rotation in the periodic time of alternation of the current.

Six values of these two currents are indicated in Fig. 12, the currents in a, c, and e, being of their maximum value in coils 1, 12, and nought in coils 11, 112; while in b, d, and f, the currents in the four coils are equal, 1 of the maximum value. The arrow indiby a suspended compass needle, the point of the arrow indicating the north-seeking pole of the compass needle. If in place of the suspended compass needle there be a piece of copper, currents will be induced in this copper by

If in place of the suspended compass needle there be a piece of copper, currents will be induced in this copper by the rotating magnetic field, tending to make the cylinder produced in the same considerable of the region of the ring, and supported so that it can rotate about this axis, the cylinder will the axis coinciding with the axis of the ring, and supported so that it can rotate about this axis, the cylinder will run after the rotating field until it catches it up, when the two will move nearly synchronously together that is, on making the motor do work—the speed of the cylinder will be checked, but a small diminution of speed will cause large curients to be induced in the copper, and a pulling force to be exerted between the rotating round. Hence this arrangement of Prof Ferraris produces not merely a self-starting alternate current motor, but one which runs aimost synchronously with the dynamo for wide variations in the load, and which has neither conventions of the control of the control

Within the past few weeks we have learnt that the idea of obtaining a rotating magnetic field was mentioned by M. Marcel Deprez, in a French patent dated May

the copper cylinder originally used by Prof. Ferrans was next made hollow, and the interno filled with soft iron, the iron being laminated in planes at right angles to the axis, to prevent currents being induced in the iron; and to make the currents induced in the copper cylinder follow the most useful path the next step was to make a number of cuts through the hollow copper cylinder parallel to the axis of rotation Practically, then, the rotating portion becomes a luminated cylinder for iron, on which is Semens armature, but with end for the cylinder some cleaning the complex properties of the cylinder of the cyli

A two-phase alternate current motor was constructed and used by Piof Ferrars in his laboratory at Turn in 1885. But not appreciating the practical importance of an own invention, and thinking that no motor requiring his own invention, and thinking that no motor requiring philosopher, Prof Ferrars occupied himself with attempts to utilize the rotatory magnetic field in measuring the reastance of conductors and with mathematical investigations on alternate currents. If was not, therefore, until coins on alternate currents if was not provided in the published; when, a few months later, commercial motors based on exactly the same punciples were brought ory.

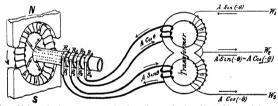


FIG. 13.—Schuckeri two-phase alternate current generator and transformer the arrows indicate the actual direction of the currents for the position of the armature shown

1883. In that patent, when speaking of the magnetic field produced by the current flowing round a Gramme ring, he says: "I celte rolation duckamp magnetique peut des obtains and fune moverous causes picks, pour ela obtain sur fune moverous causes picks, pour ela obtain sur la comparte de sharpe di audi des responsable de la formation de la familia de ce champ terra alors une retuitaine dont la position di pond des intensités relatives des deux courants auns que ceta a el décret ca desses pour le comparateur des courants, il suffi de faire varier te rapport de cause de la courants, il suffi de faire varier te rapport de champ magnetiques commerciels residents, a vive cette le champ magnetiques commerciels residents, a vive cette le

It does not, however, appear to have occurred to M. Deprex that this rotation of a magnetic field might be employed to induce currents, and thus give motion to a piece of metal placed inside the Grammering; nor does he say by 90° in phase producing the exact variation of current required. Although, then, what may be called the geometrical idea of producing a rotating magnetic field was certainly clearly described by M. Depres, the credit of freedrich producing the control of applying it in the design of the two-phase alternate current motor, is due to Prof. Ferrans

To increase the strength of the rotating magnetic field,

with considerable & lat by Mr Tesla, of Pittsburg, who had been working independently in the same direction.

To produce two alternate currents, differing by 90' in phase, the following device (Fig. 13) may be adopted, and is the one employed by Messrs Schuckert in transituting power at 2000 volts from the Palm Garden at Frankfert to the Exhibition, and by Messrs Stemens and Frankfert to the Exhibition, and by Messrs Stemens and Haiske for experiments in rotatory field alternate current not employing the special form of transformer shows anymbolically in Fig. 13. In addition to the armature of a Graname dynamo being joined up in the well-known way with the ordinary direct current commutator (this commutator and brushes rubbing on it not being shown in Fig. 13). In addition to the armature on the fig. 13, In the property of the commutator of the property of the commutator and brushes rubbing on it not being shown in Fig. 13). In the property of the metal rings, R₁, R₂, R₃, and R₄, which rotate with the machine is producing a direct current, used for exciting the field magnets as well as for any other purpose desired, the current passing through the wires brushes B₁, B₂, and the current passing through the wires brushes B₃, B₄, and the current passing through the wires as the since function of the time, the one reaching its maximum value when the other is nought.

The actual machine employed for this purpose by direct current, it will rotate as a motor generating the Mestrs. Schucket is the multiplient dynamo shown in two identate currents, and also doing mechanical work Fig. 14, the direct current commitator and brushes, as if required, lastly, if supplied with the two alternate well as the four rings and brushes for the two alternating cu tents, it will wook as a twe-phase alternate current.

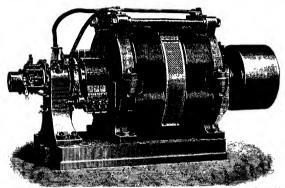


Fig. 14 -Schuckert's two-plane alternate current gene

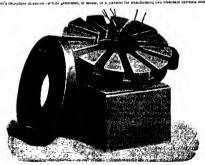


Fig. 15 -- Schuckert two-phase alternate current transformer (method of construction).

currents, being here seen. If rotated mechanically, it motor generating a direct current, as well as design will produce a direct current, as well as two alternating mechanical work.

currents differing by 90' in planse, if supplied with a | When transmitting power to a distance, the iwo-phase

alternate potential differences are transformed up from about 100 to 2000 volts; and to enable the transmission to be effected with three wires instead of four, Messis Schuckert arrange the transformer at each end of the line

The actual method employed by Messrs. Schuckert for winding this special transformer, as well as its appearance when completed, are seen from Figs. 15 and 16. This transformer, then, instead of consisting of merely a double

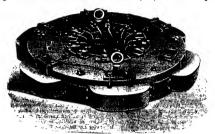


Fig. 16 -Schuckers two 1 b ve alternate correct transformer (completed)

as shown symbolically in Fig. 13. Hence, if the currents produced by the dynamo be represented by A $\sin\theta$ and A $\cos\theta$, the currents in the man wires, W, Wi, and W, will be represented by A $\cos(-\theta)$, A $\sin(-\theta)$, and A $\sin(-\theta) + \cos(-\theta)$ respectively.

ring of laminated iron as indicated in the symbolical diagram, Fig. 13, may be regarded as being composed of a connected series of laminated iron rings, each of a wedge-shaped cross-section

(To be continued)

THE OXFORD UNIVERSITY MUSEUM

THE following memorandum is based, not only upon observations made during a recent visit to Oxford, but also upon a fairly intimate knowledge of the origin and progress of the different de participate of the Muscuin, acquired at various intervals of time extending over more than thirty veers.

In entering upon the consideration of the subject which you have referred to me, it will first be necessary to define the purposes for which the Museum is maintained. These I take to be somewhat mainfold, but they may be classed.

I take to be somewhat manifold, but they may be classed as follows:—

A. The first and main purpose is undoubtedly to assist in the educational work of the University, by illustrating

the teaching of the professors and lecturers
Besides this, however, it subserves, to a greater or less
degree, other and what may be considered, as compared
with the first, secondary, but nevertheless important functions. These sie—
B. The exhibition of a collection, arranged in a sys-

B. The exhibition of a collection, arranged in a systematic, orderly, and attractive manner, open to the inspection, under proper regulations, of all members of the colony, which shall tend to sawken and keep up an interest in various subjects of which most educated persons, besides those actually engaged at the moment in obtaining materiality, dearer to possess some knowledge. Such as a space of general culture adjunct to the University.

C. Certain collections have already, and possibly will in future, become added to the general Museum, the aim and scope of which reach beyond either of the above,

Prof Flower's Report to the Committee on Collections appointed by the Delegates of the University Muscum, Oxford, dated March 14, 1891

NO. 1148, VOL. 44]

being of value, not to the ordinary student, not to the man or winnan of average general culture, but only to the advanced student who wishes to enter seriously into the pursuit of some special branch of knowledge Such is the Hope Collection of Insectis, and to a certain extent

the Pitt-Rivers Ethnographical Collection
It is a grave question how far such collections should be
maintained at the cost of the University. On the one
hand, they must be a cusse of eyenes, without which no
langer and better ordered they are, the greater must be
larger and better ordered they are, the greater must be
thegoest of maintaining them. Unless properly cared for,
not only as regards actual preservation of the objects
arrangements and augmentations necessitated by the advance of science, they will become comparatively valueless
in the course of time. If the care of many such collections were undertaken unaccompanied by special endowsuch as only a pational institution could afford. Become

On the other hand, looking at the University, not merely as a place for the education of youth, but also as a center of culture for the whole country, the possessor, or some such culticroins is of person for the country, the control of the country, but also as the person of the country, but also from distant places, to wast the University, or even to become permanent real-subjects interesting to scholarly whose numbers are very limited, have long been recognized. From the same point of vew, special collections of rive specimens of natural history or works of art may take their place in the general history or works of art may take their place in the general collections.

sideration as to whether the means will be forthcoming to maintain them in a state of efficiency

I have alluded to the Put-Rivers Collection as coming partly under this head, but, admirably and instructively displayed as it now is, it may also be considered as belonging to my second category; and the numerous human interests awakened by a study of its contents, and the many branches of culture it comes in contact with make it an adjunct to the Museum, of the great importance of which no one should entertain a doubt I should be glad to remark, in passing that the building in which it is housed appears to me the most successful, as regards economy of space, capacity for orderly arrangement, and good lighting, of any with which I am acquainted

The next point for consideration is the nature and extent of the subjects to be illustrated in the Museum (excluding the special Pitt-Rivers Collection just referred to). These seem already to have been determined as including inese seem aireacy to nave oeen cereimined as infusing physiology, human anatomy, comparative anatomy, animal morphology, geology, pathological anatomy, pakrontology, geology, and mineralogy, therefore the whole of animal biology (botany being provided for elsewhere), with the addition of geology and mineralogy. The teaching of these subjects is divided between the Regius Professor of Medicine, the Waynstete Professor of Physiology, the Linacre Professor of Human and Comparative Anatomy, the Lecturer in Human Anatomy, the Hope Professor of Zoology, the Professors of Geology and of Mineralogy It must be recognized by everyone that the boundaries of these subjects are most difficult to define, and must be constantly shifting with the advance of knowledge instance, comparative anatomy and paleontology may both be included under the broad general heading of zoology, which without the aid of both can be but imperfectly understood Whatever dividing lines are drawn between different sections of the collection, identical specimens are often required to illustrate more than one subject. The remains of extinct animals are required to complete the story of their living representatives, they are also required to illustrate the ancient history of the earth, and to define the progress of geological time and the order and succession of strata The relation between the collections used to illustrate the teaching of the Waynflete. the Line e, and the Hope Professors, must also be more or less arbitrary and artificial. In all these matters mutual convenience must be studied, and the specimens which he on the borderland of two subjects should be made in some way available for the teaching of both, otherwise a great duplication will be necessary

With regard to general administration, it appears to me desirable that there should be a governing body for the whole Museum, comparable to the standing com-mittee of the Trustees of the British Museum, or the Museum Committee of the Royal College of Surgeons, or the Museums Syndicate of the University of Cambridge. The Delegates constitute such a body at Oxford, but possibly their constitution or powers might be modified and more clearly defined than they seem to be at present

This body should be composed of members of the University specially selected for fitness for the office; seven or nine would probably be the most convenient number, so that representatives may be found upon it of various branches of science included in the Museum, and also some members of general business or administrative capacity. They should meet at occasional and stated intervals, and should determine general questions affecting the Museum as a whole, the relations of its component elements one to another, the allotment of space and the apportionment of the grants for the service of each department, the general control of expenditure, and also the care of the building, furniture, &c It is not advisable that they should interfere with the details of the arrangement of each department as long as these appear to be

The Keeper of the Museum satisfactorily carried out. should be the active executive officer of this governing body, carrying out their views in the intervals of the meetings, and bringing before their notice any subjects which seem to require their consideration

Each professor, as the representative of the most advanced state of knowledge of his subject, should be the responsible curator of the specimens belonging to his department, having such assistance provided him as may be needful He should be called upon to present to the governing body an annual report of the condition of the collections under his care, and of the accessions which

The actual specimens in the various collections will naturally arrange themselves, both as regards the purpose for which they are kept, and their mode of conservation, under three distinct classes

 Norking set, mostly of common objects, which, if damaged, can be leadily replaced, and which can be put at the disposition of the ordinary student to examine and handle Such collections are absolutely essential to practical teaching, but they should form no part of the per-manent Museum of the University, and should be kept in the rooms specially devoted to study

2 The permanent exhibited series displayed in the grand court and corridors of the Museum, the use of which, in addition to teaching students, is referred to under the heading B, near the beginning of this report Great care is required in selecting and arranging these, as well as in their preservation and display. Every specimen exhibited should have a definite object, and should be so placed that it can be thoroughly well seen
As a general rule they should be so arranged as to show what they are intended to teach without moving them from their places, and if this must be done under proper restrictions, all due precautions should be used that they do not become damaged or destroyed Although for the purposes of custody, arrangement, and nomenclature, these must be under the care of a particular professor. they are in a certain sense the common property of all who have a right of access to the Museum. This is another reason for not removing them from their places (apart from the injury that might thereby accrue to them) without definite cause, as they should be always available for study, the pro'essors and demonstrators rather bringing their classes to them than removing them to the class-rooms

The collections kept for advanced researches Although these are not exhibited in the ordinary sense of the word, they should, if retained at all, be kept in a situation and under conditions which make them readily accessible to all who can profit by their examination under suitable regulations Their preservation is of the utmost importance in the progress of science, as among them are often to be found zoological "types," or the individual specimens upon which the name of the species was instituted, and which must be referred to by zoologists for all future time in cases of difficulty in determining that name To permit the loss or deterioration of a "type' specimen is a serious offence in the eyes of the zon-

specimen is a serious ouence in the eyes or the sor-logist. The Hope Collection abounds in such types. Nothing more need be said at present about the first and third of these sections of the Museum, but the second, the exhibited series occupying the body of the great hall, requires consideration in a little more detail.

It is divided at present into—

(1) Mineralogy. Of the value and arrangement of this section I am not competent to speak

(2) Geology. This collection is mainly palæontological, and the arrangement appears to be partly stratigraphical and partly zoological in many groups the collection is rich, but taking it altogether there appears to be a number of unnecessary duplicates, and much rearrangement is required to bring it into good exhibition and teaching order. I would suggest that in a collection illustrating geology (and not the zoology of extinct animals, so often in museums confounded with that science) the stratigraphical arrangement should be followed as strictly as possible, and also that there should be a good series illustrating dynamical geology, or the processes by which that the strating dynamical geology, or the processes by which the strating dynamical geology or the processes by which the strating dynamical geology.

(3) Animal Biology. This section occupies about twothirds of the floor space of the Museum, and is at present broken up into various small series involving much repe tition and duplication, and also difficulty of finding any

particular object or illustration required

In the middle of the hall is a series of specimens merely showing the external appearance of certain groups of animals, stuffed vertebrates and the shells of mollusks, and stony skeletons of corals, &c. If this collection were incorporated in the general series of animal biology, not only would much duplication be avoided, but a more Many of the present specimens of this series, especially the mounted unamnals and birds, are in such bad condition that they have no educational value—they only mulead instead of teaching; but before destroying them they should all be submitted to the examination of some expert in the group to which they belong, as there may be interesting or rare specimens among them, though observer in their oresent condition.

The imperfection of any coological series that does not illustrate extinct as well as recent forms is continually becoming more apparent as science advances, some attempts have already been made to remedy this defect in the zoological series, but a considerable transfer of specimens to it from the department of geology will

result in advantage to both.

By a rearrangement of the biological series, with incorporation of the so-called toological specimens (excluding the Hope Collection, which I presume is always to be kept apart) much economy of space could be effected, and some of the confusion which now appears to evist in this department of the Museum in consequence of the numerous apparently independent series of specimens will be obviated.

will be moviated to the primary arrangement of the bological collection, whether on the physiological for Hunterian system, or upon a system based upon roo-logical classification, will have to be carefully considered Much is to be said for either, but whichever is adopted Much is to be said for either, but whichever is adopted abould follow the method of teaching of the professor and his assistants. The point to be aimed at is that should be such that the professor and his assistants. The point to be aimed at is that have also also the position with other specimens which are related to it, and which should be studied in conjunction with it. As the classification of animals, except as regards the greater divisions, is still a matter of much uncertainty, and continually changing according to the advance of not a satisfactory basis for the arrangement of a collection intended to illustrate principles rather than details On the other hand, the Hunterian system often brings into justaposition specimens related only by some remote analogy of function, and having no real correspondence or homology. Though we have been also the story of the secondary divisions, will, on the whole, be found most convenient.

I am hardly in a position to say how far the Professor bettowed upon it. An ill-arranged mixed of Physiology requires a special collection to illustrate compared to the letters of the alphabet in teaching. Probably the general hological series with the scaling probably the general hological series with the state of the same letters placed in such orderly like sectures, especially as the tendency of modern phy-produce words of counsel and instruction

siology seems to be to separate itself from morphology, and confine itself more to biological chemistry and dynamics

Another question which has been raised is, whether human anatomy, as distinguished from general pology, requires a separate section of the Museum, and how the great and important colles tool of crania of the races of men, which under Prof. Rolleston became one of the special features of the Museum, should be treated and utilized for instruction. These are questions that time will probably solve. Much depends upon the with the will probably solve. Much depends upon the with the of the dates of the Lectures on Human Anatomy, whether the should teach upon a broad and philosophical basis, or of the dates of the Lectures on Human Anatomy, whether has been supported by the examining bodies. But this trenches upon the larger and more complex subject of what should be the aim of the University in keeping up a Medical vision.

the Pathological Collection will, of course, remain as at present under the care of the Professor of Medicine In looking round the Museum at the present time, one of its greatest wants appears to me to be proper labelling.
The different sections of the Museum should be distinctly marked off from each other Every case should have a conspicuous label on the top of it, indicating the nature of its contents Every specimen should have one in-dicating why it is there and what it teaches This will This will involve a large amount of labour and expense in printing. but it is absolutely necessary, if the collections are to fulfil the purpose for which they are formed It is a mistake to spend much time, labour, and cost in oblaining, preparing, and preserving a specimen, and then to stop short of the one thing needed to make it of use. Better have fewer specimens in a complete state. A printing press might be established in the building and kept constantly at work, but as it would be difficult to apportion the claims upon its services of the different curators, it might be better to make an arrangement with the University Press by which labels (of a uniform with the University Press by which labels (of a uniform character) for the whole Museum would be printed at a fixed charge, and paul for out of the funds of the depar-ment requiring them As in a large number of cases only a single copy of a label is required, it is possible that some system of type-writing might be more economical, and nearly, if not quite, as effectual

Of the importance of complete catalogues of every department of the Museum, it would seem almost superfluous to speak, were it not obvious that much is needed

in this respect

Lastly, it appears to me that, although more work-crooms and class-rooms may be necessary for the growing needs of the scientific departments of the University, there is ample space in the present building for some time to come for the exhibited portion of the Misseum time to come for the exhibited portion of the Misseum valuable hispects, and do great credit to the seal and energy of those by whom they have been-brought together, what is really required now is, not so much that they should be increased, at that they should be better arranged, mens should be gradually replaced by better ones. Oxford has done very much in past times to initiate and keep up a high standard of museum work, but it must not be overflowed that great advances are being made in this respect, not only in this country but all over the Countients, work if both laborous and costly, but when done the result is fully commensurate to the labour and expense bestowed upon it. An ill-arranged museum has been well compared to the letters of the alphabet tossed about in-discriminately, necessing in othing; a well-varranged one-down discriminately, necessing in thing; a well-varranged one-produce works of counsel and instruction.

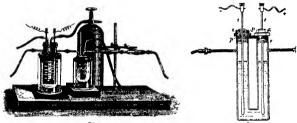
FURTHER RESEARCHES UPON THE ELEMENT FLUORINE.

SINCE the publication by M. Mossan of his celebrated paper in the Annatet de Chimie et de Physique for succeeded in solution by the Annatet de Chimie et de Physique for succeeded in soluting this remetable paesons lement, a considerable amount of additional information has been acquired concerning the chemical behaviour of flaorine, and important additions and improvements have been introduced in the apparatus employed for preparing gathers together the results of these subsequent researches—some of which have been published by him from time to time as contributions to various French scientific journals, while others have not hitherto been made known—and publishes them in a long but most interesting paper Physique. Inamuch as the experiments described are of so extraordinary a nature, owing to the intense chemical activity of flooring, and are so important as filling a long existing vacancy in our chemical literature, readers of NATORE will doubless be interested in a birt account of

IMPROVED APPARATUS FOR PREPARING FLUORINE.

In his paper of 1887, the main outlines of which were given in Nature at the time (1887, vol xxxvi p 179),

This improved form of the apparatus is abown in the accompanying figure (Fig. 1), which is reproduced from the memor of M. Moissan It consist essentially of two parts—the electrolysis apparatus and the purifying vessels. The electrolysis apparatus is sectional release of the electrolysis apparatus, and sectional release across the electrolysis apparatus, a sectional release across the electrolysis apparatus, a sectional release across the electrolysis apparatus, a sectional release across the electrolysis across the electrolysis, across of the limbs of the U-tube. A key of brass, E serves to screw or unscrew the stoppers, and between the flange of each stopper and the top of each branch of the hermetic closing is effected. These fluor-spar stoppers, which are covered with a coating of gum-lac during the electrolysis, carry the electrole rold, r, which are thus perfectly insulated M. Moissan now employs electrodes interior end of each is incheend into a club shape in order the longer to withstand corrosion. The apparatus immersed during the electrolysis in a bath of loquid methyl chloride, maintained in tranquil ebullition at ~25.



PIG I

M. Moissan showed that pure hydrofluoric acid readily dissolves the double fluoride of potassium and hydrogen, and that the liquid this obtained is a good conductor of and that the liquid this obtained is a good conductor of membered that, by passing a strong current of electricity through this liquid contained in a plantum apparatus, free gaseous fluorine was obtained at the positive pole and hydrogen at the negative pole. The amount of hydrodinoric acid employed in these earlier experiments was about fifteen grains, about ax grams of hydrogen polassium flooride, H. E. being added in order to render the strong that the strong and the positive pole and the polassium flooride, H. E. being added in order to render the strong that the strong and important additions have been made, by means of which the fluorine is delivered in a pure state, free from admixed vapour of the very volatile hydroluoric acid, and mayor and admixed vapour of the very volatile hydroluoric acid, and mayor and such the fluorine is delivered by it strong a hydroluoric acid, and more apparatus, and upwards of four litres of pure fluorine is delivered by it per hour.

NO. 1148, VOL. 44]

glass cylinder containing fragments of calcium chloride; by this means it is surrounded with a layer of dry air, a bad conductor of heat The purifying vessels are three in number. The first

consists of a platinum spiral worm-tube, of about 40 cc. capacity, numericed also in a bith ofliquid methyl chloride, maintained at as low a temperature as possible, about 750° As byfordisoric acid bolis at 19° S. (Mossan), almost the whole of the vapour of this substance which is activated at the bottom of the worm. To remove the control and tractical at the bottom of the worm. To remove the control and tractical at the bottom of the worm. To remove the control and tractical at the bottom of the worm. To remove the control and the cont

pressed. During the electrolysis these leaden collars becomes, where exposed to the gaseous fluorine, rapidly converted into lead fluoride, which, being greater in bulk, causes the joints to become hermicially sealed. In order to effect the electrolysis, 26 to 28 Bunnen elements employed, arranged in series. An ampre-emister and a remployed, arranged in series. An ampre-emister and a electrolysis apparatus; the former affording an excellent indication of the progress of the electrolysis.

As the U-tube contains far more hydrofluoric acid than can be used in one day, each lateral delivery-tube is fitted with a metallic screw stopper, so that the experiments may be discontinued at any time, and the apparatus closed
The whole electrolysis vessel is then placed under a glassbell-iar containing dry air, and kept in a refrigerator until again required for use. In this way it may be preserved full of acid for several weeks, ready at any time for the preparation of the gas. Considerable care requires to be exercised not to admit the vapour of methyl chloride into the U-tube, as otherwise violent detonations are liable to occur. When the liquid methyl chloride is being introduced into the cylinder, the whole apparatus becomes surrounded with an atmosphere of its vapour, and as the platinum U-tube is at the same instant suddenly cooled, the vapour is liable to enter by the abducting tubes Consequently, as soon as the current is allowed to pass and fluorine is liberated within the U-tube, an explosion occurs Fluorine instantly decomposes methyl chloride, with production of flame and formation of fluorides of hydrogen and carbon, liberation of chlorine, and occasionally deposition of carbon In order to avoid this unpleasant occurrence, when the methyl chloride is being introduced the ends of the lateral delivery-tubes are attached to long lengths of caoutchouc tubing, supplied at their ends with calcium chloride drying tubes, so as to convey dry air from outside the atmosphere of methyl chloride vapour. If great care is taken to obtain the minimum temperature, this difficulty may be even more simply overcome by employing mixture of well-pounded ice and salt instead of methyl chloride; but there is the counterbalancing disadvantage to be considered, that such a cooling bath requires much in we frequent renewal

CHEMICAL REACTIONS OLCURRING DURING THE ELECTROLYSIS

In the paper of 1887, M. Moissan adopted the view that the first action of the electric current was to effect the decomposition of the composition of the solution in the hydroflore said, thouse the consistency of the hydroflore said, the most experience of the positive pole, and potassium at the negative terminal. This liberated potassium would at once regenerate potassium fluorde in presence of hydrofluoric acid, and liberate its equivalent of hydrogen.

$$KF = K + F$$

 $K + HF = KF + H$

But when the progress of the electrolysis is carefully sollowed, by consulting the indications of the amperemeter placed in circuit, it is found to be by no means as regular as the preceding formulae would indicate. With the new apparatus, the decomposition is quite irregular proceeding for upwards of two hours. Upon stopping the current and unmounting the apparatus, the platinum red apon which the fluorine was liberated is found to be largely corroded, and at the bottom of the U-tube a quantity of a black, finely divided substance is observed. This black substance, which was taken at first to be admitted to the control of the c

complicated than was at first considered to be the case. The maxture of acid and alkaline fluonide furnishes fluorine at the positive terminal rod, but this intensely active gas, in its basecin state, articles, the platinum and case the state of the st

PHYSICAL PROPERTIES OF FIVORINE

Fluorine possesses an odour which M Moissan compares to a mixture of hypochlorous and and nitrogen peroxide, but this odour is sually masked by that of the ozone which it always produces in moist air, owing to its decomposition of the water uppour It produces most serious unitation of the bronchial tubes and mucous membrane of the nisal cavities, the effects of which

membrane of the nasal cavities, the effects of which are persistent for quite a formight. When examined in a thickness of one metre, it is seen to possess a greenish-jellow colour, but paler, and containing more of yellow, than that of chlorine. In such a layer, fluorine does not precent any absorption-bands, alsey, fluorine does not precent any absorption-bands between wave-lengths 744 and 162. Their positions and relative intensities are as follows:

At a temperature of -95° at ordinary atmospheric pressure, fluorine remains gaseous, no sign of liquefaction having been observed

METHODS OF EXPERIMENTING WITH FLUORINF. When it is desired to determine the action of fluorine upon a solid substance, the following method of procedure is adopted A preliminary experiment is first made, in order to obtain some idea as to the degree of energy of the reaction, by bringing a little of the solid, placed upon the lid of a platinum crucible held in a pair preparation apparatus If a gaseous or liquid product results, and it is desirable to collect it for examination, small fragments of the solid are placed in a platinum tube connected to the delivery-tube by flexible platinum tubing or by a screw joint, and the resulting gas may be collected over water or mercury, or the liquid condensed in a cooled cylinder of platinum. In this manner the action of fluorine upon sulphur and todine has been studied. If the solid, phosphorus fer instance, attacks platmum, or the temperature of the reaction is sufficiently high to determine the combination of platinum and fluorine (towards 500'), a tube of fluor-spar is substituted for the platinum tube. The fluor spar tubes employed by M Moissan for the study of the action of phosphorus were about twelve to fourteen centimetres long, and were terminated by platinum ends furnished with flanges and screw threads in order to be able to connect them with the preparation apparatus If it is required to heat the fluor-spar tubes, they are surrounded by a closely wound

copper sparal, which may be heated by a Bunsen flame. In experimenting upon liquids, grait care is necessary, as the reaction frequently occurs with explosive violence. A preliminary experiment is therefore always made, by allowing the fluorine delivery-tube to dup just beneath the wurface of the liquid contained in a small glass cylinder. When the liquid contains water or when

hydrofluoric acid is a product of the reaction, cylinders of platinum or of fluor-spar are employed. If it is re-ouired to collect and examine the product, the liquid is placed along the bottom of a horizontal tube of platinum or fluor-spar, as in case of solids, connected directly with the preparation apparatus, and the product is collected over water or mercury if a gas, or in a cooled platinum receiver if a liquid.

During the examination of liquids a means has accidentally been discovered by which a glass tube may be filled with fluorine gas A few liquids, one of which is carbon tetrachloride, react only very slowly with fluorine at the ordinary temperature By filing a glass tube with such a liquid, and inverting it over a platinum capsule also containing the liquid, it is possible to displace the liquid by fluorine, which, as the walls are wet, does not attack the glass. Or the glass tube may be filled with the liquid, and then the latter poured out, leaving the walls wet, the tube may then be filled with fluorine gas, which, being slightly heavier than air, remains in the tube for some time test-tube had been filled with fluorine over carbon tetrachloride, it was attempted to transfer it to a graduated tube over mercury, but in inclining the test-tube for this purpose, the mercury suddenly came in contact with the fluorine, and absorbed it so instantaneously and with such a violent detonation that both the test-tube and the owing to the powerful affinity of mercury for fluorine, it is a most dangerous experiment to transfer a tube containing fluorine gas, filled according to either the first or second method, to the mercury trough, the tube is always shattered if the mercury comes in contact with the gas, and generally with a loud detonation Fluorine may, however, be preserved for some time in tubes over mercury, provided a few drops of the non reacting liquid

are kept above the inercury meniscus

For studying the action of fluorine on gases, a special piece of apparatus, shown in Fig. 3, has been constructed



It is composed of a tube of platinum, fifteen centimetres long, closed by two plates of clear, transparent, and colourless fluor-spar, and carrying three lateral narrower tubes also of platinum. Two of these tubes face each other in the centre of the apparatus, and serve one for the conveyance of the fluorine and the other of the gas to be experimented upon. The third, which is of someto be experimented upper and unit, which is of some-that greater diameter than the other two, serves as exti-tible for the product or products of the reaction, and may be placed in connection with a trough containing either water or mercury. The apparatus is first filled with the gas to be experimented upon, then the fluoque is allowed to enter, and an observation of what occurs. may be made through the fluor-spar windows. One most important precaution to take in collecting the gaseous products over mercury is not to permit the platinum delivery-tube to dip more than two or at most three

become so different owing to the pressure, that the fluorine from one side mixes with the hydrogen evolved upon the other, and there is a violent explosion.

ACTION OF FLUORINE UPON THE NON-METALLIC

Hydrogen —As just described, hydrogen combines with fluorine, even at - 23° and in the dark, with explosive force This is the only case in which two elementary ga-es unite directly without the intervention of extraneous ga-es unite directly without the intervention of extraneous energy if the end of the tube delivering fluorine is placed in an atmosphere of hydrogen, a very hot blue flame, bordered with red, at once appears at the mouth of the tube, and vapour of hydrofluoric acid is produced.

Ovygen,-Fluorine has not been found capable of uniting with oxygen up to a temperature of 500°. On ozone, however, it appears to exert some action, as will be evident from the following experiment lt was shown in 1887 that fluorine decomposes water, forming hydrofluoric acid, and liberating oxygen in the form of ozone. When a few drops of water are placed in the apparatus shown in Fig 3, and fluorine allowed to enter, the water is instantly decomposed, and on looking through the fluor-spar ends a thick dark cloud is seen over the spot where each drop of water had previously been This cloud soon diminishes in intensity, and is eventually replaced by a beautiful blue gas—ozone in a state of considerable density. If the product is chased out by a stream of nitrogen as soon as the dense cloud is formed, a very strong odour is perceived, different from that of either fluorine or ozone, but which soon gives place to the unmistakable odour of ozone. It appears as if there is at first produced an unstable oxide of fluorine, which rapidly decomposes into fluorine and

Nitrogen and chloring appear not to react with fluorine

Sulphur .- In contact with fluorine gas, sulphur rapidly melts and inflames A gaseous fluoride of sulphur is formed, which possesses a most penetrating odour, somewhat resembling that of chloride of sulphur. The gas wnat resembling that of chloride of sulphur. The gas is incombustible, even in oxygen. When warmed in a glass vessel, the latter becomes etched, owing to the formation of silicon tetrafluoride, 51⁴, Selenium and tellurium behave similarly, but form crystalline solid fluorides

Biomine vapour combines with fluorine in the cold with roduction of a very bright but low-temperature flame. If the fluorine is evolved in the midst of pure dry liquid bromine, the combination is immediate, and occurs without flame

Todine —When fluorine is passed over a fragment of sodine contained in the horizontal tube, combination occurs, with production of a pale flame. A very heavy liquid, colourless when free from dissolved iodine, and furning strongly in the air, condenses in the cooled receiver. This liquid fluoride of iodine attacks glass with great energy, and decomposes water when dropped into that liquid with a noise like that produced by red-bot iron. Its properties agree with those of the fluoride of iodine prepared by Gore by the action of iodine on silver fluoride.

Phosphorus.—Immediately phosphorus, either the ordinary yellow variety or red phosphorus, comes in contact nary yellow variety or red prospronts, comes in contact with fluorine, a most lively action occurs, accompanied by vivid incandescence. If the fluorine is in excess, a furning gas is evolved, which gives up it sexess of fluorine on collecting over mercury, and is soluble in water. This gas is phosphorus pentialluoride, Pf., prepared some years ago by Prof. Thorpe If, on the contrary, the phosphorus is in excess, a gaseous mixture of this pentafluoride with a new fluoride, the trifluoride, PF, millimetres under the mercury, as otherwise the levels of a gas insoluble in water, but which may be absorbed by the liquid in the two limbs of the electrolysis U-tube caustic potash, is obtained. The trifluoride, in turn, combines with more fluorine to form the pentafluoride, the reaction being accompanied by the appearance of a flame of comparatively low temperature.

Arsenic combines with fluorine at the ordinary tem-erature with incandescence If the current of fluorine perature with incandescence. If the current or nuotine is fairly rapid, a colourless furning liquid condenses in the receiver, which is mainly arsenic triflioride, A8F, but which appears also to contain a new fluoride, the pentafluoride, AsF₃, masmuch as the solution in water yields the reactions of both arsenious and arsenic acids

Carbon - Chlorine does not unite with carbon even at the high temperature of the electric arc, but fluorine reacts even at the ordinary temperature with finely-divided carbon. Purified lampblack inflames instantly with great brilliancy, as do also the lighter varieties of wood charcoal A curious phenomenon is noticed with wood charcoal it appears at first to absorb and condense the fluorine, then quite suddenly it bursts into flame with bright scintilla-tions. The denser varities of charcoal require warming to 50° or 60' before they inflame, but if once the combustion is started at any point it rapidly propagates itself throughout the entire piece. Graphite must be heated to just below dull redness in order to effect combination . while the diamond has not yet been attacked by fluorine, even at the temperature of the Bunsen flame. A mixture of gaseous fluorides of carbon are produced whenever carbon of any variety is acted upon by fluorine, the predominating constituent being the tetrafluoride, CF.

Horon—The amorphious variety of boron inflames

instantly in fluorine, with projection of brilliant sparks and liberation of dense fumes of boron triflionide, BF, adamantine modification behaves similarly if powdered When the experiment is performed in the fluor-spar tube, the gaseous fluoride may be collected over mercury The gas fumes strongly in the an, and is in-

stantly decomposed by water

Silicon -The reaction between fluorine and silicon is one of the most beautiful of all these extraordinary manifestations of chemical activity

The cold crystals become immediately white-hot, and the silicon burns with a very hot flame, scattering showers of star-like, white-hot particles in all directions. If the action is stopped before all the silicon is consumed, the residue is found to be As crystalline silicon only melts at a tempera-The control of the co

ACTION OF FLUORINE UPON METALS

Sodium and potassium combine with fluorine with great vigour at ordinary temperatures, becoming incandescent, and forming their respective fluorides, which may be obtained crystallized from water in cubes Metallic calcium also burns in fluorine gas, forming the fused fluorine, and occasionally minute crystals of fluor-spar Thallium is rapidly converted to fluoride at ordinary temperatures, the temperature rising until the metal melts and finally becomes red-hot Powdered magnesium burns with becomes red-hot Powdered magnessum burns with great brilliancy. Iron, reduced by hydrogen, combines in the cold with immediate incandescence, and formation of an anhydrous, readily soluble, white fluoride Aluminium, on heating to low redness, gives a very beautiful luminosity, as do also chromium and manganese. The combustion of slightly warmed zinc in fluorine is particularly pretty as an experiment, the flame being of a most dazzling whiteness. Animony takes fire at the ordinary temperature, and forms a solid white fluoride. Lead and mercury are attacked in the cold, as previously described, the latter with great rapidity. Copper reacts at low redness, but in a strangely feeble manner, and the white fumes formed appear to combine with a further quantity of fluorine to form a perfluoride

The main product is a volatile white fluoride

Sifteer is only slowly attacked in the cold. When heated, however, to 100°, the metal commences to be covered with a yellow coat of anhydrous fluoride, and on heating to low redness combination occurs, with incandescence, and the resulting fluoride becomes fused, and afterwards presents a satin-like aspect. Gold becomes converted into a yellow deliquescent volatile fluoride when heated to low redness, and at a slightly higher temperature the fluoride is dissociated into metallic gold and

fluorine gas. The action of fluorine on platinum has been studied with special care. It is evident, in view of the corrosion of the positive platinum terminal of the electrolysis apparatus, that nascent fluorine rapidly attacks platinum at a temperature of - 23° At 100°, however, fluorine gas a temperature of -23° At 100°, however, huoring gas appears to be without action on plantium. At 500°-500° it is attacked strongly, with formation of the tetra-fluoride, PtF4, and a small quantity of the protofluoride, PtF4. If the fluoriue is admixed with vapour of hydroa fluoric acid, the reaction is much more vigorous, as if a fluorhydrate of the tetrafluoride, perhaps 21HF PtF₆, were formed The tetrafluoride is generally found in the form of deep-red fused masses, or small yellow crysta's resembling those of anhydrous platinum chloride resembling those of anhydrous platinum choride I had salt is volatile and very hygroscopic. Its behaviour with water is peculiar With a small quantity of water a brownish-jellow solution is formed, which, however, in a very short time becomes warm and the fluoride decoming the salt of the salt very snort time occomes warm and the mortice accomposes; platinic hydrates precipitated, and freehydrofluonic acid remains in solution. If the quantity of water is greater, the solution may be preserved for some minutes without dicomposition. If the liquid is boiled, it decomposes instantly At a red heat platinic fluoride decomposes into metallic platinum and fluorine, which is evolved in the free state. This reaction can therefore be employed as a ready means of preparing fluorine, the fluoride only requiring to be heated rapidly to redness in a platinum tube closed at one end, when crystallized silicon held at the open end will be found to immediately take fire in the escaping fluorine. The best mode of obtaining the fluoride of platinum for this purpose is to heat a bundle of platinum wires to low redness in the fluor-spar reaction tube in a rapid stream of fluorine. As soon as sufficient fluoride is formed on the wires, they are transferred to a well-stoppered dry glass tube, until required for the preparation of fluorine.

ACTION OF FIUORINE UPON NON-METALLIC COMPOUNDS

Sulphuretted hydrogen -- When the horizontal tube shown in Fig. 3 is filled with sulphuretted hydrogen gas and fluorine is allowed to enter, a blue fiame is observed on looking through the fluor-spar windows playing around the spot where the fluorine is being admitted. The desulphide is converted into gaseous fluorides of hydrogen and sulphur.

Sulphur droxide is likewise decomposed in the cold, with production of a yellow flame and formation of fluoride of sulphur

Hydrochloru acid gas is also decomposed at ordinary temperatures with flame, and, if there is not a large excess of hydrochloric acid present, with detonation Hydro-fluoric acid and free chlorine are the products Gaseous hydrobromic and hydrodic acids react with

fluoribe in a similar manner, with production of flame and formation of hydrofluoric acid Inasmuch, however, as bromine and iodine combine with fluorine, as previously described, these halogens do not escape, but burn up to their respective fluorides. When fluorine is delivered into an aqueous solution of hydriodic acid, each bubble as it enters produces a flash of flame, and if the fluorine is being evolved fairly rapidly there is a series of very

violent detonations A curious reaction also occurs when fluorine is similarly passed into a 50 per cent aqueous solution of hydrofluoric acid itself, a flame being produced in the middle of the liquid, accompanied by a carine of detonations

Nitric acid vapour reacts with great violence with fluorine, a loud explosion resulting If fluorine is passed into the ordinary liquid acid, each bubble as it enters produces a flame in the liquid

Ammonta gas is decomposed by fluorine with forma tion of a yellow flame, forming hydrofluoric acid and liberating nitrogen. With a solution of the gas in water, each bubble of fluorine produces an explosion and flame. as in case of hydriodic acid

Phosphoric anhydride, when heated to low redness, burns with a pale flame in fluorine, forming a gaseous mixture of fluorides and oxylluoride of phosphorus. Pentachloride and trichloride of phosphorus both react most energetically with fluorine, instantly producing a brilliant flame, and evolving a mixture of phosphorus pentafluoride and

free chlorine

Arsenious anhydride also affords a brilliant combustion, forming the liquid trifluoride of arsenic, AsF. This liquid in turn appears to react with more fluorine with considerable evolution of heat, probably forning the pentafluoride, AsF. Chloride of arienc, AsCl, is converted with considerable energy to the trifluoride, free chlorine being liberated

Carbon bisulphide inflames in the cold in contact with Careen as in parameter in the could in contact with fluorine, and if the fluorine is led into the midst of the fluoring a similar production of fixme occurs under the surface of the liquid, as in case of nitric acid. No carbon is deposited, both the carbon and sulphur being entirely converted into gaseous fluorides.

Carbon t. trachloride, as previously mentioned, reacts only very slowly with fluorine The liquid may be saturated with gaseous fluorine at 15°, but on boiling this liquid a gaseous mixture is evolved, one constituent of which is cirbon terafluoride, CF4, a gas readily capable of absorp-tion by alcoholic potash. The remainder consists of another fluoride of carbon, incapable of absorption by potash, and chlorine A mixture of the vapours of carbon tetrachloride and fluorine inflames spontaneously with detonation, and chlorine is liberated without deposition of carbon

Boric anhydride is raised to a most vivid incandescence by fluorine, the experiment being rendered very beautiful by the abundant white fumes of the trifluoride which are

Silican diaxide, one of the most mert of substances at the ordinary temperature, takes fire in the cold in contact with fluorine, becoming instantly white-hot, and rapidly disappearing in the form of silicon tetrafluoride The chlorides of both boron and silicon are decomposed by fluorine, with formation of fluorides and liberation of chlorine, the reaction being accompanied by the production of flame.

ACTION OF FLUORING UPON METALLIC COMPOUNDS.

Chlorides of the metals are instantly decomposed by fluorine, generally at the ordinary temperature, and in certain cases, antimony trichloride for instance, with the appearance of flame Chlorine is in each case liberated, and a fluoride of the metal formed. A few require heating, when a similar decomposition occurs, often accompanied by incandescence, as in case of chromium sesquichlbride.

Bronudes and rodides are decomposed with even greater energy, and the liberated bromine and iodine burn in the fluorine with formation of their respective fluorides

Cyanides react in a most beautiful manner with fluerine, the displaced cyanogen burning with a purple flame. Potassium ferrocyanide in particular affords a very pretty

NO. 1148, VOL. 447

experiment, and reacts in the cold Ordinary potassium cyanide requires slightly warming in order to start the

combustion.

Fused potash yields potassium fluoride and ozone. Aqueous potash does not form potassium hypofluorite when fluorine is bubbled into it, but only potassium fluoride Lame becomes most brilliantly incandescent. owing partly to the excess being raised to a very high temperature by the heat developed during the decomposition, and partly to the phosphorescence of the calcium fluoride formed.

Sulphides of the alkalies and alkaline earths are also immediately rendered incandescent, fluorides of the metal

and sulphur being respectively formed.

Boron nutrade behaves in an exceedingly beautiful manner, being attacked in the cold, and emitting a brilliant blue light which is surrounded by a halo of the fumes of

boron fluoride

Suiphates, nitrates, and phosphates generally require the application of more or less heat, when they too are rapidly and energetically decomposed Calcium phos-phate is attacked in the cold like lime, giving out a brilliant white light, and producing calcium fluoride and gaseous oxyfluoride of phosphorus, POF, Calcium carbonate also becomes raised to brilliant incandescence when exposed to fluorine gas, as does also normal sodium carbonate, but curiously enough the bicarbonates of the alkalies do not react with fluorine even at red heat. Perhaps this may be explained by the fact that fluorine has no action at available temperatures upon carbon dioxide

ACTION OF ILUORINF UPON A FEW ORGANIC COMPOUNDS.

Chloroform - When chloroform is saturated with fluorine, and subsequently boiled carbon tetrafluoride, hydrofluoric acid and chlorine are evolved. If a drop of chloroform is agitated in a glass tube with excess of fluorine, a violent explosion suddenly occurs, accompanied by a flash of flame, and the tube is shattered to pieces. The reaction is very lively when fluorine is evolved in the midst of a quantity of chloroform, a persistent flame burns beneath the surface of the liquid, carbon is deposited, and fluorides of hydrogen and carbon are evolved together with chlorine

Methyl chlaride is decomposed by fluorine, even at -23°. with production of a yellow flame, deposition of carbon, and liberation of fluorides of hydrogen and carbon and free chlorine With the vapour of methyl chloride, as pointed out in the description of the electrolysis, violent explosions occur

Ethyl alcohol vapour at once takes fire in fluorine gas, and the liquid is decomposed with explosive violence without deposition of carbon. Aldehyde is formed to a considerable extent during the reaction.

Accts aced and bensene are both decomposed with violence, their cold vapours burn in fluorine, and when the latter is bubbled through the liquids themselves, flashes of flame, and often most dangerous explosions, occur. In the case of benzene, carbon is deposited, and with both liquids fluorides of hydrogen and carbon are evolved Amisne likewise takes fire in fluorine, and deposits a large quantity of carbon, which, however, if the fluorine is in excess, burns away completely to carbon tetrafluoride.

Such are the main outlines of these later researches of M. Moissan, and they cannot fail to impress those who read them with the prodigious nature of the forces associated with those minutest of entities, the chemical atoms, as exhibited at their maximum, in so far as our knowledge at present goes, in the case of the element fluorine.

A. E. TUTTON.

THE HUXLEY LABORATORY FOR BIOLOGICAL RESEARCH, AND THE MARSHALL SCHOLARSHIP

SCIENTIFIC friends and former pupils of Prof Huxley will alike be gratified to learn that an appropriate method has been devised for establishing a permanent memorial of his great services to the insti-tution with which his name has been so long identified The late Sir Warington Smyth, whose loss we had to de-plore rather more than a year ago, was the last surviving member of the original staff of the School of Mines, as founded by Sir Henry de la Beche in 1851. Prof Huxley, who, as long ago as 1854, succeeded Edward Forbes in the Chair of Natural History, continues to hold the post of Honorary Dean of the Royal College of Science, with which the School of Mines is now incorporated, and although, since 1885, compelled by ill lealth to discontinue the work of lecturing, he is still, we are happy to say, able to take a kindly interest in, and to exercise a general supervision over, the biological studies carried on in the school

How much the Central Institution for training teachers in science, which is now located at South Kensington, owes to the organizing faculty and unremitting labours of Prof. Huxley, only those who have been associated with him in the work can form any just estimate During the first twenty years of its existence all attempts at practical teaching in the School of Mines were restricted to the subjects of chemistry and metallurgy, the space available in the Jermyn Street buildings only permitting of the existence of very small and inconvenient laboratories in

connection with those two branches of science.

Soon after the first establishment of the school, larger and more convenient premises for carrying on the chemi-cal instruction had to be obtained in Oxford Street, and in 18/2, on the unanimous recommendation of the Council, the teaching of chemistry, physics, and biology, was transferred to the building at South Kensington, which had been originally designed as a School of Naval Ar hitecture. At subsequent dates, as the inadequacy of the Jermyn Street buildings to accommodate both the school and the Geological Survey made itself more strongly felt, the divisions of geology, mineralogy, metal-lurgy, applied mechanics, and mining, were successively

removed to the same place.

No sooner did Prof. Huxley find an opportunity afforded to him, than he energetically devoted himself to the realization of a long-cherished scheme for establish-ing a system of practical laboratory-instruction in biology, including both its goological and its botanical aspects. The ground was broken by a short vacation course, in which an attempt was made to supply such practical instruction to persons engaged in teaching, this course was given in the summer of 1871, and in the following year the same system of laboratory-instruction in biology was introduced into the ordinary School of Mines curriculum In establishing at South Kensington the biological laboratory which has become the model of so many similar institutions at home and abroad, Prof. Huxley sought and obtained the advice and co-operation of many of his fellow-workers in science, among whom may be specially mentioned Profs Michael among whom may be specially mentioned Profis Michael Forcer, Thiselfon Dyer, Ray Lankester, and Rutherford, Forcer, Thiselfon Dyer, Ray Lankester, and Rutherford, Forcer, Thiselfond, The Lankester, and Rutherford, Forcer, Forcer,

bining original research with the work of teaching No one at the present day needs to be reminded of the mannerous important investigations which have been

prosecuted by Prof. Huxley, both at Jermyn Street and South Kensington Memoirs of the highest value on various branches of comparative anatomy and palæontology have been interspersed with notable contributions to geology, to anthropology, and to botany, and from time to time excursions have been made still farther afield (predatory excursions they were regarded by some), into realms of thought more remote from the ordinary domain of the zoologist But in all these varied avocations the interests of the teaching work were never forgotten; and it was made evident that the teacher, while carrying on investigations himself, was ever ready to suggest, stimulate, and supervise the investigations of others

When, in 1885, ill-health compelled Prof Huxley to relinquish his daily occupations in the school, it was found that, during the more than thirty years' occupancy of his post, he had accumulated a most valuable library of research, composed of treatises and journals dealing
with every branch of biological science This library he This library he generously determined to present to the institution, the interests of which he had so long and earnestly laboured to promote The Council of the School, in accepting this valuable gift, recommended that the room where these books were kept, and in which Prof Huxley had so long carried on his work, should be entirely set apart for biological research, and the proposal at once met with the

Lducation

The Huxley Laboratory for Biological Research is now arranged to accommodate twostudents, who will undertake botany, or palacontology, the work being carried on under the supervision of the professors and assistant professors of the school. With a valuable library and all necessary appliances for work supplied to them, it may be hoped that the genus loca will not be without its influence upon these research students, and that a long series of important observations may be made, which will constitute an enduring and a worthy memorial of Prof Huxley's connexion with the school

It happens, very opportunely, that something in the way of a small endowment has already been provided to and this scheme of biological research. As long ago as 1882, Miss Sarah Marshall, of Warwick Gardens, sington, wrote to Prof Huxley, informing him of her intention to bequeath the sum of Lioco, and her scientific books and instruments, to the Department of Science and Art, with a view to the establishment of a prize or scholarship in biology, in memory of her father, the late Mr Marshall of the Bank of England By the recent death of Miss Marshall, this bequest has now passed into the hands of the Lords of the Committee of Council on Education, and, by the advice of the Council of the Royal College of Science, it has been decided that the interest of the legacy shall be annually paid as a scholarship to a meritorious student, to aid him in carrying on some biological investigation in the Huxley Laboratory. only hope that this modest attempt at the endowment of research may be attended with success, and that this success may be so conspicuous as to encourage others to imitate the example of Miss Marshall, so that bequests of a similar character may be made in connexion with this and other institutions where scientific researches can be carried on

ON VAN DER WAALS'S TREATMENT OF LAPLACE'S PRESSURE IN THE VIRIAL EQUATION; IN ANSWER TO LORD RAY-LEIGH.

MY DEAR LORD RAYLEIGH, -- From the heading of your first letter, and from the wide scope of the passage you quoted from my paper, I imagined that you intended to raise the whole question of Van der Waals's

treatment of Laplace's pressure. Otherwise I should not, in my answer, have referred to his \(\tilde{\ell} \) or to the unfortunate results of comparing his formula with experiment. I should, in fact, have contented myself with the acknowledgment that you had given an accurate account of the contents of a portion of Van deer Waals's earlier chapters, which I had carelessly missed on the first hasty perusal, and that these contents justified the expression \(\tilde{\ell} \) for the principle of \(\tilde{\ell} \) and the time of \(\tilde{\ell} \) and that \(\tilde{\ell} \) for \(\tilde{\ell} \) and that \(\tilde{\ell} \) for \(\tilde{\ell} \) and that \(\tilde{\ell} \) for \(\tilde{\ell} \) for \(\tilde{\ell} \) in \(\tilde{\ell} \) and that \(\tilde{\ell} \) for \(\tilde{\ell} \) of \(\tilde{\ell} \) in \(\tilde{\ell} \) for \(\tilde{\ell} \) in \(\tilde{\ell} \) in \(\tilde{\ell} \) of \(\tilde{\ell} \) in \(\ti

For (1) that passage contains the distinct statement that, from the statical point of view, reasons "satisfactory on the whole" were given by Van der Waals for regarding Laplace's pressure as proportional to the square of the density. And it would have been illogical on my part to object, except on the ground of insufficient generality, to the equation

$$(p + \frac{a}{n!})v = \frac{1}{2}\Sigma(mu),$$

though I might have regarded the mode of its establishment as obscure or even doubtful,

In fact, the equation which is one of the main features of my own paper, viz.

$$pv + \frac{\Lambda}{v + a} = \frac{1}{2}\Sigma(mu') \left(1 + \frac{\epsilon}{v + a}\right),$$

includes it as the particular case when e = 0, a = 0

What I objected to was a totally different thing —viz the above equation manipulated by the introduction of the factor $(\nu - \delta)/\nu$ in the left-hand member Again (2) the equation

$$p(v - \beta) = \frac{1}{2}2(mu^2)$$

is obtained in my paper (§ 64), and is there spoken of as "perfectly legitimate," but only on the distinct condition

$$\beta \Xi (m u^2)/3 v$$

where β is four times the sum of the volumes of the particle (§ 20), "be small in unpharam with the other particle (§ 20), "be small in unpharam with the other hands of the quantity $\beta(u, b)$ states, this implies that for the truth of the quantin $\beta(u)$ must be a small fraction, and it is most certainly not so at the critical point of carbonic acid, which furnished the first and one of the most important cases for the application of the virial method. In fact the equation above, when correctly obtained, in fact the equation above, when correctly obtained, preserved) must be form (in which it cought to be preserved).

$$pv = \frac{1}{3}\mathbb{I}(mu) \left(1 + \frac{\beta}{\nu}\right);$$

again a particular case of my own equation, viz. when $A = 0, \quad a = 0, \quad c = 8$

Here the factor (m, m) is using the property of the factor (m, m) is the factor (m, m) in the capacity that is appears in the equation. At I and that capacity that is appears in the equation. At I and in my former letter, it is impossible (at least with Van der Waals's mode of interpreting $X(mu^n)$) to derive from this cubic (m, m) is even when the term ab^n is introduced as a cubic (m, m) cere when the term ab^n is moduced as a cubic (m, m) in the constant (m, m) in the constant (m, m) is (m, m) in place of (m + b) (m, m), and (m, m) is (m, m) in place of (m + b) (m, m) in right-hand side, which is, practically, what (m, m) is (m, m) is (m, m) in the constant (m, m) in the constant (m, m) is (m, m) in the constant (m, m) in the constant (m, m) is (m, m). This can, to a certain each at least, be justified, the other method can not.

On the question of the introduction by Van der Waais of the factor $(\nu - b)/\nu$, whether or not it is applied alike to

and to K. I regret to find that our views must continue to differ For it appears to me that when once the various terms of the virial equation have been correctly extracted from the expression Z(Rr), we have no right to modify any of them. There seems therefore to be no doubt whatever that the procedure in Van der Waals's sixth chapter is entirely wrong in principle -except in so far as (in the German version) he borrows some correct expressions from Lorentz. The meanings of v and of p, in the term po of the virial equation, are (from the very beginning of the inquiry) definitely assigned as total volume and external pressure .- so that this term cannot in any way be altered No more can the term 2(mu2)/3, or the ratio of these two terms Van der Waals's argument seems (for his pamphlet is everywhere somewhat obscure) to be that nis paintinct is everywhere somewar obscure; to be that when there is no molecular force) in consequence of the finite diameters of the particles the pressure, for a given amount of kinetic energy, and the greater than if these ware more points. Perfectly true—but we must seek the expression for this increase of pressure in the remaining expression for this increase of pressure in the remaining parts of the term x(Rr), and mot artificially introduce it by diminishing the multiplier of p in a term already definitely extracted. And further, if this procedure of Van der Waals were allowed to pass without protest in so far as the term pv is concerned, 1 think that we should logically be forced to treat the term Kv (not to the same but) to a very different factor :- for here the consideration of the finite volumes of the particles would appear to call for a reduced rather than an increased value of K : and therefore analogy would require a multiplication of the term Kv by some such expression as $(v+\gamma)/v$, where γ is essentially positive -- Yours very truly,

Edinburgh, 17/10/01

NOTES.

To-ray the Senate of Cambridge University will details whether official inquiry shall be made as to the expediency allowing alternatives for one of the voc classical languages in the most of the state of the control of the state of the

Tite ordinary general meeting of the Institution of Mechanical Engineers began yesterday evening, and will be continued this evening, at 25 Great George Street, Westminster. The papers to be read and discussed, as we have already stated, are by Mr. Samuel Bawell and Prof W. C. Roberts-Austen, F. R.S.

THE Geologist's Association will hold a conversatione at University College, Gower Street, on Friday evening, November 6 Members are invited to send exhibits, and to let the accretary know the nature of the object or objects they propose to show.

Ar the meeting of the Royal Horticultural Society in the Poli Hall, Westimater, or Tuesday, there was an interesting duplay of autumn foliage arranged for authent effect. A lecture was delivered by Mr H. J. Vetch, who urged that trees and alreads an gardens and plantations should be selected, not only with a view to their autumner besury, but also with regard to only with a view to their autumner besury, but also with regard to the various ways in which these hasts may be most effectively contrasted

PROF. BOYS has arranged his apparatus for the repetition of the Carendish experiment in the basement of the Clarendon Laboratory, Oxford. The experiment will be proceeded with immediately.

WE regret to have to record the death of Dr. Philip Herbert Carpenter, F R.S., the fourth son of the late Dr. W. B. Carpenter, CB, F.RS He was found dead in his dressingroom at Eton College, on Wednesday, October 21 At the inquest it was found that he had killed himself by the administration of chloroform during temporary insanity Dr Carpenter was in his fortieth year, and had been a science master in Eton since 1877. The following summary of his scientific work in given by the Times. He was a member of the scientific staff of the deep sea exploring expeditions of Her Maiesty's steamships Lightning (1868) and Percupine (1869-70), and in 1875 he was appointed assistant naturalist to Her Majesty's ship Valorous, which accompanied Sir G. Nares's Arctic expedition to Disco Island, and spent the summer sounding and dredging in Days Strait and the North Atlantic Dr. Carpenter devoted himself continuously from 1875 to studying the morphology of the Echinoderms, more particularly of the Crinoids, both recent and fossil In 1883 he was awarded the Lyell Fund by the Geological Society of London in recognition of the value of his work, and in 1885 was elected a Fellow of the Royal Society His chief memoirs and papers were as follows -" Notes on Echinoderm Morphology," 1-x1, 1878-87, "On the Genus Actinometra," 1877, "Report upon the Crinoidea dredged hy H.M.S Challenger," Part I "The Stalked Crinoids," 1885, Part Il "The Comatule," 1888; "Report upon the Comatulm dredged by the U S Coast Survey in the Caribbean Sca," 1890. In conjunction with Mr. R Etheridge, Jun., he prepared the "Catalogue of the Blastoidea in the Geological Department of the liritish Museum," 1886, and he also wrote numerous papers published in the Proceedings or Transactions of the Royal, Linnean, and Geological Societies

MR. GEORGE SIBLEY, who was for many years well known as an engineer in India, and had also n considerable reputation as a traveller, ided at his residence at Catherham on Sunday last at the age of ixiy seven. It is understood that Mr. Sibley has left a legacy for the purpose of founding engineering scholar-shaps in the University of Calcutte.

DA J. EDUARD POLAK, who died at Vienna on October 8, at the age of sevenity one, was one of the most enamel Persans cholars of his time. He went in 185 to Teheran, where he level at the medical school, and became physician to the Shah. Daring his nine pears' seudence in Persan he visited most part in of the country, and on his return to Vienna he work in well-known work, "Persano, das Land und seine Bewohner," in which he pre-ented an excellent aummary of the knowledge he had sequired. In response to an invitation from the Shah, he again wisted Teheran. He read before the Geographical and Anthropological Societies of Vienna many valuable papers on Persan and its antiquates.

THE International Geological excursion in America, which started on September 2 last, ended on October 9 after a most successful and interesting trip. In all there were ninety geo logists, and the arrangements as regards trains, &c., left nothing to be desired. The route chosen lay through the petroleum districts of Pennsylvania, the praines of Wisconsin, Minnesota, and Dakotah, the corn-lands of North America, and the twin centres St Paul and Minnespolis. From the Yellowstone River the party journeyed to the beautiful geyser region of the National Park, where they made a stay of seven days, then to the rising mountain district of Butte, as well as to the Mormon town situated in the middle of the salt wastes of the Great Salt Lake. They then skirted the table-lands in South Utah, and turned towards the Rocky Mountains, where they visited the chief places of geological laterest, including Pike's Peak, the Garden of the Gods, &c At this point many of the party returned home, going by way of Chicago, Niagara Falls, and New York. The smaller number that remained undertook a laborious and exhausting expedition through the deserts of New Mexico and Arisona to the San Francisco mountains and to the Grand Calino of Colorado, they visited a group of 165 volcances and craters, and also a deep valley the sales of which, with their many and varous coloured stones, fall 360 to 6000 feet to the great Colorado River below From this standpoint they had an excellent view of the materials composing the upper surfaces of the earth's crust, and they could not but be struck by the magnitude and grandeur of the work accomplished by Nature in digging out the enormous river calono. The following are some of the places visuated on the return journey. La Jinta, Kaisasa City, Chicago, Niagara Falls, Albany, and Boston. Allocghethe the excursion was a thorough success, and the Amencana deserve much credit for having arranged so good a programme for their visitors.

PROF RUSEIL and his party have returned from the Alaska wide, which they penetrated to a distance of forty miles inland, from Iry Bay to the base of Mount St. Eliast. They constructed a camp, and remainer there two months, making geological surveys and taking observations. Prof. Rassell assi—"We began the ascent of Mount St. Elias on Jane 3. Our progress was not obstructed until we reached an attitude for early 10,000 feet. There we found glacers. After many persions attenuers we attenued the baself contraction of the condition of the condition

THE report by Mr. James Dredge and Sir. Henry Trueman Wood on their recent with to Cheego us printed in the Journal of the Society of Aris (October 2). Thu report was presented ast week to the Royal Commission which his been appointed to organize the English Section at the Chicago." World's Fair." The Commission have devided to appoint the following Committees: Finance, Fine Aris, Indian, Colomal, Eugmeering, Ceneral Manufactures, Fletericity, Agriculture, Mines and Metallurgy, Lextle Industries, Science and Education, Transportation, also a Committee of Leddes to Correspond with the Ladest Committee at Chicago. They propose to invite the assistance of Chamberts of Commerce as Local Committees. A prospectize relating to the Chicago Exhibition has been issued by the Royal Commission.

THE Council of the Institution of Civil Engineers have issued for general circulation their regulations as to the admission of students. This is followed by an excellent account of the various educational institutions in the British dominions where instruction is given bearing on the profession of civil engineers.

In his report on the working of the Central Museum, Madras, during 1890-91, Mr Edgar Thurston, the Superintendent, notes that he made two official tours in company with his taxidermists During the first of these, as in several previous years, he stayed on Ramesvaram Island, where he was mainly engaged in the collection and preservation of marine worms and molluscan shells, which have since been sent to England and Germany to be worked up Many specimens of the brightly coloured "coral-fishes," which abound over the fringing coralreefs, were also preserved by the glycerine process introduced by Mr. A. Haly, of the Colombo Museum, for the preservation of colours. His stay on Ramesvaram Island completed, he paid a short visit to Tuticorin, to work out some doubtful points in connection with the anatomy of the pearl oyster. In his second. tour he made large collections illus rative of the arts, industries, manufactures, and natural history of the places visited in the Bangalore, Hassen, Shlmoga, and Mysore districts. These collections include Srávanbelgola brass-ware, Soráb and Sagar

sandal wood carring, Channapatna silk and toys, Mysore inlaid ware, gold jewellery from Beliur, batterfles, lizards, nakas, &c. A report on tha tour will be published after a farther vant to the Mysore province, a large area of which remains to be explored.

THE other day, Mr Flinders Petrie delivered at the Owens College. Manchester, a most interesting address on exploration in Egypt. It had been thought, he said, that the immense mounds of rubbish indicating the sites of towns had been made on purpose, but they resulted from the natural decay of the mad-brick buildings. These heaps of runed walls and earth and potsherds rose even to eighty feet high in some places; but other ancient sites were much less imposing, and might even not attract notice on the open desert The higher the mound the tonger the place had been inhabited, and if the surface was of a late period, the earlier parts, which were most needed, were under such a depth of rubbish as to be practically maccessible Much could be known at first sight, and prospecting had now become as scientific a matter in antiquities as in geology Knowing, by a glance at the sherds on the top, what was the latest period of occupation of the site, and knowing the usual rate of accumulation of a mud-brick town-about five feet in a century -- we could guess how far back the bottom of the mound must be dated. Other remains had different indications. If in the midst of a great mound there was a wide flat crater, that was probably the temple site, surrounded by houses which had accumulated high on all sides of it Speaking of the results of exploration. Mr Petrie said that we now realized what the course of the arts had been in Egypt In the earliest days yet known to us-about 4000 B C .- we found great skill in executing accurate and massive stonework, such skill as liad hardly ever been exceeded We found elaborate tools used, jewelled saws and tubular drills. We saw the pictorial arts as fully developed as they were for thousands of years later But what led up to this we were still feeling for.

To what uses did primitive men apply the stone haum which they made in such large numbers? This question Mr. J D McGuire tries to answer in a paper in the American Authiopologist for October 11is theory is that the liammer was probably "the tool upon which races living in the Stone Age celled more than upon any other object to fashion stone implements " It was used, he thinks, not only to peck an axe or celt into shape, but to rub or polish the implement after it had been shaped, and, to illustrate this, he gives a figure representing a typical hammer of quartzite, from McMinn County, Tennessee, the periphery of which is pitted by use, while the flattened sides show that it must have been a rubbing stone as well To prove that the work suggested could be done by a stone hammer, he represents an axe of close-grained black porphyry, which he himself pecked out and grooved by means of such an implement. The task occupied him about five hours. As ordinary stone axes are made of softer material, he thinks they were probably produced in a much shorter time,

Ds. H vost WitsLockti contributes to the current number of Chibuta a supplied paper on the handlerfish of Hungarian gypties, whom he has had many opportunities of observing. If we may judge from the illustrations, they have a considerable aptitude for dengn in the summer they make bottles out of prompkins, which they decorate with various drawings. On cut into the uppermost sone, serpents into the second one, circles into the third, and signs lines into the footh. The crosses mean "May you be happy it", the serpents, "May you have no occurse it", the crickes, "May you always have money!" the signs lines, "May you be healthy!" Brandy is kept in the bottle; a nod when a great in excerved, the

first gypsy who drinks says, "May you be happy !"; the second, "May you have no enemies!"-and so on, Pretty walkingsticks are also among the things made by the Hungarian gypsies. On the top of one of those sketched in the article two female heads are admirably carved. These represent Ana, the Queen of the Keschalyis, or forest fairies, who dwell among the mountains, where they sit-three being always togetheron rocks, spreading out their long hair over the valleys, thus giving rise to mists. Queen Ana lives in a black palace, and sometimes wanders over the world in the form of a frog. Frogs, toads, and serpents are her favourite animals. When she meets anyone in her natural form, she exclaims "Ana!" which means "Bring!" Should the person understand the cry and bring a frog. a toad, or a serpent, he is richly rewarded If he fails to do so, he is either killed with a piece of a rock, or struck by some terrible malady

THF Times of October 22 has an interesting article on "Our Position with regard to Rainfall," compiled from the statistics published by Mr. Symons and the Meteorological Office The rainfall during the present month has been so heavy that In many places the amount up to the morning of the 18th was in excess of the average for the whole month In London this excess amounted only to o 3 inch, while at Valentia Island and at Stornoway it amounted to nearly 2 and 3 inches respectively, and the amount which fell during the next few days has greatly increased the excess. But for the to years ending with 1830 the rainfall over the United Kingdom differed only by t per cent from the average of the last 50 years. The values for the present year, up to the 18th Instant (as shown by the last Weekly Weather Report then published), were rather in excess of the average over the southern, midland, and western parts of England, and the north of Scotland, while in the re maining districts there was still a deficiency. For the whole period since the end of 1880, there was only one district, viz. Scotland (N). in which the total fall was in excess of the average. In Scotland and the midland and south-western counties of England, the deficiency was still very large The question is asked-Are we likely to have in the years immediately advancing more or less rain than during the last few years? While the question can not be answered with absolute confidence, the grouping of years into decades or other regular periods eliminates most of the non periodic variations, and shows whether any secular alterations are taking place. There is no doubt that since 1887, at all events, the rainfall over England has been much below the average; and a consideration of all the facts leads to the conclusion that such a period of scarcity is very likely to be followed by one of abandance, and that the coming few years will probably be more rainy than those recently experienced, although possibly the increase will not occur in the summer months-at a time when it would be most noticed.

THE new number of Petermann's Mitthinugen opens with some interesting extracts from the diary of the late Dr. Anton Stecker, written during his journey in Alysania and the Galla contines in 1850-83. Stecker dide before he had an opportunity of writing a full and systematic account of his irrevial. In the present extracts he notes not only the physical characteristics of the regions to which they relate, but the manness reader to trace this route.

A GREEK guidencr lately expressed the opinion that oranges, figs, olives, and grapes grops in Australia are inferior to those grown at Smyrna and Athens. This having been brought to the attention of the Department of Agriculture, New South Wales, letters were addressed to the British Consuls at Naples and Marseilles saking for a consignment of the best varieties of grapes, figs, and olivies grown in Italy and France. On receipt of these

cutings, experiments are to be carred out at the most saliable of the experimental stations should to be established throughout the colony, with a view to the propagation of the finest wanettee of the respective fruits. With the same object in vew application has been made to Mr. T. Hardy, of South Australia, for a number of extinge of various vines be has cultivated, and to Sir Samuel Davenport, of Reaumont, South Australia, for cuttings of the olive and fig treet grown by him. The whole of these of the olive and fig treet grown by him. The whole of these different kinds of fruit which it is mineded to establish at each of the experimental stations.

In the Revue Agricole, published in Mauritius, M. A. Daruly de Grandprégives an account of his attempts to raise sugar cane from seeds. The seeds were sent from Barbados by the Governor in March 1890 M de Grandpie planted them with the greatest care, and after five days was fortunate enough to obtain five minute seedlings out of the hundred seeds used The young plants he raised did not all prove equally vigorous, and he was able to save only one, which, at the time when his report was written, had formed a fine clump of twenty shoots with long ribbon leaves. "I believe," he says, "that we may with reason cherish the most sanguine hopes from the propagation of sugar cane from seeds-more especially if we try an intelligent system of cross-fertilization of the varieties we possess-rather than by planting cuttings, which maintain without appreciable alteration the respective characteristics of the parent plants. Thus we shall be able to supplement the weak points in our best varieties of sugar-cane by crossing them with others which are remarkable for the qualities it is intended to infuse into them, and we shall moreover obtain, by a process of selection, a cane rich in saucharine matter, which will enable us to compete successfully against the highly improved sugar-beet."

Ms. A. W. MORRIS contributes to the current number of the Journal of the Bombay Natural History Socsety an interesting paper on abnormal horas of the Indian anticlope. We have as well little definite information as to the cause or causes of such abnormalities. Mr. Morris suggests that severe injuries to the skull, inflicted either during hattie or through some seculent, are the main causes that produce abnormalities, the horn on the causion of themse a tustantool. Or in natural course by the concusions of efames rustantool.

THE Academy of Natural Sciences of Philadelphia prints in its Proceedings a list of the Echinoderms obtained by Mr. Frederick Stearns, of Detroit, in the Bahama Islands in the years 1887 and 1888. The list has been drawn up by Mr. J. E. Itsell Litelludes a description of a new species of Amphura

A VALUABLE revised list of British Echinoidea, by Mr William E. Hoyle, has been printed in the Proceedings of the Royal Physical Society, Edinburgh, and is now issued separately. The author gives a brief diagnosis of each species, such as will enable the collector to identify in on the spot.

MESSEX, J. AND A. CHUKCHILL have published a second edition of the Engish transition of Dr. A Chauvers's "Comparative Anatomy of the Domesticated Animals." Dr. George Fleming is the transitor and editor. In preparing the new edition, Dr. Fleming has kept in view the accessities of al, vancing veteransy education in the Engish-speaking schools. He has introduced, therefore, a considerable number of "amendments, alteration, and additions".

MESSES. HENRY SORHERAN AND CO. propose to issue a work entitled "Game Birds and Shooting Sketches," by J. G. Millais, F.Z. S. The work will illustrate the habits, modes of capture, and stages of plumage of game birds, and the hybrids and varieties which occur among them

NO. 1148, VOL. 44]

THE University College of North Wales has issued its Calendar for the year 1891-92

LECTURES on the following subjects will be given at the Royal Victoria Hall on Tuesday evenings during the month of November ...—November 3, Mr F. W. Rudler, "Some Very Ancient Britons", November 10, Dr Rideal, "London Fogs", November 17, Dr W. D. Hallbutton, "Skin and Bones" (second lecture), November 24, Rev C E Brooke, "A Holday in the Far West"

Titz additions to the Zoological Society's Gardens during the past week include a Winter fronti-Leurus (Leurus algebras algebras 1) from Madagascar, presented by Mr. J. M. Nicholl, a Ring-land Coats (Masser step) from South America, presented by Mr. J. M. Nicholl, a Ring-Beropean, presented by Mr. Lower Harry E. Z. S., two Common Cuckoos (Cuesture cannorsh, British, presented respectively) by Mr. II. Landay and Miye Orl. a Burbot (Labe welgarray). From the Trent, presented by Mr. F. T. Barrows, a Macaque Monkey (Massers symmolique 4) from India, a loud Marmost (Madar renalsa) from South-Least Brard, an Australian Cassowary (Cussarras cantalsa) from Mautrials, deposited

OUR ASTRONOMICAL COLUMN.

THE ZODACAL LIGHT AND ALKNOW — On he supportion that the zodacat light is an extremo of the solar corona, and that the latter munity consust of light reflected from mettorities to the plane of the equator, My, M. A. Veeder explain (Rochester Academy of Sciences, January 26, 1891) why modile [Antieste the phenomenous hugglest in March and modile [Antieste the phenomenous hugglest in March and sunnite, and also the fact that at these times one margin of the modile and the period of the solar period of autore and magnetic period of the solar period of autore and magnetic period of the solar period of autore and magnetic period of the solar period of autore and magnetic period of the solar period of autore and magnetic period of the solar period of autore and magnetic period of autore and autore

coercising originates, and not neight neconic all continues contracting originates, and not neight neconic all continues or the turbations shows that they may be arranged in periods having the same length as that of a synodic rotation of the sun. And it appears that the areas issued frequencied by sun spots are most that a spear that the areas issued frequencied by sun spots are most research, Mr. Vecker believes that the held the distribution of atmosphere, bessues about the magnetic pole as a centre is very sincely dependent upon magnetic induction of solar volcanic origin, conveyed from the suit to the earth through the medium origin, conveyed from the suit to the earth through the medium

CONET c 1891 —The following orbit has been computed by Prof. Campbell for the comet discovered by Prof. Barnard on-October 2 —

On October 30 the comet is in the position R.A 10h. 53m 7s, Decl - 54° 43' It is therefore not visible in our latitudes

Two New Asperoids —A new minor planet, (ais), of the thirteenth magnitude was discovered by M. Charlois on October 8, and another, (as), by Dr. Palisa on October 11

The latter observer has given the name of Thora to (200), Olga to (201), and Fraternitas to (201).

DOUBLE STARS—M. S W Burnham announces that he is preparing a general catalogue of all the double stars discovered by him, and would be glad to receive any unpublished measures of them, Nos. 1 to 1224.

JUPITER'S FIRST SATELLITE.—Some recent observations made at Lick Observatory show that the first satellite of Jupiter is ellipsoidal, and that one of its longer axes is directed to the plane's courte.

THE INTERNATIONAL METEOROLOGICAL CONFERENCE

THIS meeting, which was more or less of a private character, as it was not organized in any way through diplomatic channels, took place at Munich from August 26 to September 2. It was held in the building of the Technical High School, and was attended by 32 members, representing most European and some extra European countries As to the latter, the United States contributed four members, while Brazil and Oueensland States contributed four members, white Brazil and Queenaland sent one each Koumania and Bulgaria for the first time took part in one of these meteorological gatherings Dr. Ilang, the head of the Bawarian meteorological system, was appointed President, and Prof. Mascart (Paris) with Prof. Harrington (Washington) Use-Presidents. The Secretairies were Dr. Erk (Washington) Vice-Presidents The Secretaries were I (Munich), Mr. Scott, and M. Teisserene de Bort (Paris)

The following is a brief summary of the most important mentact insulation of recommendations of the Conference.

All temperatures pull-thind after 1500 rate to be referred to the readings of the art thermometer Actionmetrical observations are not held to be sufficiently certain to justify their general control of the process of the conference of the con A report was also received and adopted on the arrangement. A report was also received and adopted on the observation of the motions, &c., of cirrus and other high-level clouds. Wend —Robinson's anemometer was the only form of clouds. Wind—Robinson's anemometer was the only form of instrument discussed. It was decided that no instrument results should be published unless the instrument had been previously compared with a standard, either directly or indirectly. Time.—A proposal to recommend the adoption of directly, Jim.—A proposal to recomment the anoption of universal or zone time was emphatically rejected, on the ground was further decided in all publications to insist on commencing the day with andinght as o hours. Granup correction—It was decided to introduce the practice of correcting barometrical readings for the force of gravity at lat. 45° after the beginning

readings for the force of gravity at lat. 45° after the beginning of the year 1501.

Mr. Wraggs, for Generalend, and Copatin Photolog. for Panel, Mr. Wraggs, for Generalend, and Copatin Photolog. for Panel, Mr. Wraggs, for General Panel of the State of

SOCIETIES AND ACADEMIES. PARIS.

Academy of Sciences, October 19.—M. Duchartre in the chair—Memoir on the underground temperatures observed at the Muséum d'Histoire Naturelle, duning the winter 189-91, by M. Henri Becquerel. A thermo-electric arrangement was used for the determination of the temperatures beneath two used for the determination of the temperatures beneath two surfaces, one of which was covered with sand and devoid of vegetation, whilst the other had greas and some plants growing upon it. The two solis were similar, and in each case the temperatures were taken at five points, having depthe ranging from November 1, 1890, to March 31, 1891, the temperatures being taken at 6 a.m. and 3 p.m. daily. These have been plotted, and the resulting curves stringing show the variations which coursed in the interval, and the extinction of detail with increased depth. The diarrial variation at the greatest depth was a few tenths of a degree, whilst that of the sit was shown to the contraction of the sit was shown to the contraction of the sit was shown to the site of the site

variation was the same as in air, but at all the other points the effect was reversed—that is, the temperature fell from 6 a.m. to 3 p.m., and rose during the night. It also appears from the observations that Fourier's theory of the differential relation existing between temperature, time, and depth of thermon existing between temperature, time, and depth of thermometer represents very well the propagation of heat in a superficial layer of soil, and that the coefficient of conductivity of this layer for determined conditions of humidity may be deduced from observations of underground temperatures. shi layer for determined conditions of humday may be decised from observations of undergroad teappearures. A certain thickness of earth protects the roots of plants of the control of the destroy the red corpuscies of the blood of another of a different destroy the red corpuscies of the blood of another of a different species. And the destructive power of serum for microbes is called. "pouvon microbicule". The effects produced in each case have been studied.—On the nature of the movement of the chromatophores of Cephalopods, by M. C. Phisalix,

Coptic Palmography British Museum (Natural History) Catalogues The Life and Work of a Norfolk Geologist. By W. W. Our Book Shelf:--Codrington: "The Melanesians: Studies in their Anthropology and Folk-Lore" 613 Harrison . "Gulde to Examinations in Physiography " 613 Letters to the Editor :--Difficulty in Weismannism .- Prof. Marcus Raimaking Expensions.—H A Rare Phenomenon.—W. Duppa-Crotch; Prof. W. N. Hartley, F.R.S. A. M. Antonicolo. The Juppa-votco, roc. A. M. Antonicolo. The Juppa-votco. The Juppa-votco. The Juppa-votco. The Juppa-votco. The Oxford University Museum. By Prof. W. H. Flower, F.R. S. Puther Researches upon the Element Fluorine. The Husley Laboratory for Biological Research, and the Marshell Scholarship On Van der Wasie's Treatment of Laplace's Pressure in the Virial Equation in Answer to Notes 2018. 614 615 Notsa Our Astronomical Column: The Zodiscal Light and Aurorse . . . The Zeducal Light and Aurore Comet : 180; Two New Attendid. Double Stars. 1-papier's First Satellite The International Meteorological Conference Societies and Academies. 631 631 631

CONTENTS.

PAGE

imperial agricultural resear institute library new delhi

	3	
Date of issue.	Date of serue,	Date of 18sus
19.2.45		
-		